A

NEW SYSTEM

OF

PHYSIOLOGY,

COMPREHENDING

THE LAWS BY WHICH ANIMATED BEINGS IN GENERAL, AND THE HUMAN SPECIES IN PARTICULAR, ARE GOVERNED, IN THEIR SEVERAL STATES OF HEALTH AND DISEASE.

IN TWO VOLUMES.

VOL. I.

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M.DCC.XCVIII.

TO

WILLIAM BLIZARD, Efq.

F.R.S. F.S.A.

SENIOR SURGEON TO THE LONDON HOSPITAL,

ETC. ETC. ETC.

DEAR SIR,

ACCEPT this Work as a fmall but fincere teftimony of the gratitude I feel for the knowledge and friendfhip I have received from you.

Few men who have entered the profeffion, have been bleffed with greater advantages than myfelf. On my onfet in life, I was happily placed under the affectionate and parent-like care of my eldeft brother, whofe anxiety for my improvement

could be only equalled by the zeal which you yourſelf diſplayed, and which you infuſe into the minds of thoſe who have the benefit of your inſtruction.

That the eminent abilities you poſſeſs, may long continuc to be exerted with both honour to yourſelf, and benefit to mankind, is the ardent wiſh of,

Dear Sir,

Your affectionate and

Obliged humble Servant,

Richard Saumarez.

Newington, Surrey,
Dec. 26, 1797.

PREFACE.

I SHOULD not obtrude myſelf upon the public notice, had the ſubject I have diſcuſſed been taken up by any of thoſe whoſe leiſure and ſituation may be ſuppoſed to qualify them better than me for the taſk. Notwithſtanding the boaſted improvements which, in theſe latter days, Phyſiology has attained; although its profeſſors have inveſtigated the ſolitary functions of particular organs, and have publiſhed many important detached and iſolated facts; it is however to be deplored, that none have ventured to collect and con-

nect thefe together—or to trace the dependence and relation that fubfift between the different organs by which a whole fyftem is conftituted.

The caufe is probably to be afcribed to the uncertainty that has hitherto exifted, with refpect to the power or efficient caufe by which thefe various effects are produced. In proof of this uncertainty, I need only mention the variety of fyftems that have been formed with a view of accounting for the phenomena of organic life.

By fome (the Materialifts) life and action are fuppofed inherent in matter, and that both flow from the properties which it effentially contains. By others (the Brunonians) life is affirmed to be merely an effect of which action is the caufe. This doctrine will be found merely a perverted modification of the former one, connected with fome tenets which it has borrowed from another fource. There fub-

fifts,

ſiſts, however, a ſmall band, of which the late Mr. John Hunter was the dignified chieftain, who diſclaim the doctrine which aſcribes to matter the power of forming itſelf into organs, or which ſuppoſes that life can ever ariſe out of death; much leſs that it can ever be an effect only of which matter is the cauſe. Had the two former ſyſtems, like many others that might be mentioned, been generated and died like the ephemeris of a day; it is probable that the following work would never have been written. But when I read the late tranſlation by Dr. Beddoes of the Elementa Medicinæ of Dr. Brown, in which he brings proof that it is the prevailing doctrine over Europe, as it unqueſtionably is in this country; I thought that it would be criminal in any one to remain ſilent who ſaw the error and the pernicious tendency of that doctrine, and the evils it produces in its application to practice.

To explore the nature of the principle of

life, and aſſert its power,—to inveſtigate the attributes of organized life, as the inſtrument by means of which the phenomena of organic action are produced, and the final cauſe of animated exiſtence attained throughout the univerſe, conſtitute the eſpecial object of this work.

I am aware that I have extended the power of life beyond what has been hitherto ſuppoſed, and that ſome will fancy it to be viſionary and abſurd. I ſhall however be ready to ſupport my opinions whenever called upon.

I have not formed thoſe opinions from tranſient obſervation: on the contrary, I avow that I have reflected on them with patience and intenſity; ſo that whatever errors may exiſt in the doctrinal part, ariſe from my ignorance of the ſubject.

It has been by examining the ſtructure and beholding the action of different animated beings from the moſt ſimple to the moſt complicated,

plicated,—by comparing the ftates of health and of ftrength with thofe of weaknefs and of difeafe — of different organs and of different claffes of animated beings when they feverally exift either in their active or torpid ftate, which conftitute the fources from whence my materials are principally derived; fo that I have found the ftudy of the fubject always connected with the practice of it.

There are, however, various parts about which we ftill continue ignorant. I need only mention the brain and nervous fyftem; thofe important organs, through the energy of whofe power it is probable the different functions of the machine are carried on. What I have faid of them, may be confidered as an attempt to throw out fome idea that may tend to excite further inveftigation.

As to the manner in which this work is executed, I am forry to fay that I claim all the indulgence that it is poffible for the reader to

grant. It has been written with too much velocity for me to hope that the ſtyle ſhould always be correct, or that the periods ſhould be otherwiſe than rough and unpoliſhed. I have been too often interrupted to expect that there will be found a proper connection between all the parts; and I think it probable that it occaſionally abounds with repetitions, ſometimes through deſign, and more generally from accident.

If the work ſhould have the good fortune to go through a ſecond edition, it will be my ſtudy to amend and correct it. In ſoliciting that verbal criticiſm may not be too ſevere, I ſeek for enquiry and diſcuſſion: wherever error exiſts, it ought to be detected and expoſed. Conſcious as I am of the importance of the ſubject, and the narrowneſs of my own abilities, I have only to add, that I ſhall feel thankful to receive the correction of the candid, and information from the intelligent. Animated with a love of my profeſſion, and having frequent

opportunities

opportunities in common with all to deplore the inefficacy and imperfection of it in its application to practice, I have felt it my duty to contribute my mite to its improvement. Should it be thought that I have had the good fortune to succeed, I confess that it will give me the most heartfelt satisfaction.

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PART

PART I.

A NEW SYSTEM OF PHYSIOLOGY.

CHAP. I.

ON THE GENERAL PROPERTIES OF COMMON, OF LIVING, AND OF DEAD MATTER.

The phænomena which common matter diſplays are regular and conſtant, amenable to fixed and general laws, either of mechaniſm or of chemiſtry—with living matter totally different—it reſiſts the operation of chemical and mechanical laws, and is wholly ſubſervient to the particular power of the ſyſtem by which it was organized—it thus acquires the property of preſervation with tendency to putrefaction—the power by which it is thus preſerved is called life—*the matter endowed with this living power is called* living matter—*when it loſes the participation of the living power, it decompoſes and ſeparates by the proceſſes of putrefaction and fermentation, conſtituting death and diſſolution.*

IT appears to me a ſelf-evident fact, that on this terreſtrial globe a great and ſtriking difference is found to exiſt between the properties of common and of living matter. Common matter is inherently paſſive, and, when

 left

left to itfelf, undergoes no change whatever; it never acts, unlefs it is acted upon by fome agent external to itfelf: whenever common matter is acted upon, and motion produced, the motion produced perpetually diminifhes until it is loft: the matter gradually verges from the active ftate into which it had been excited, into a paffive and quiefcent one, in which condition it remains. This is the effect that conftantly and invariably enfues, when one mafs of matter is made to act upon another: the firft lofes as much of its own motion as it imparts to the fecond; fo that the degree of motion that is excited in the one, entirely depends on the quantity of moving power communicated and received from the other: and finally, if a chemical union takes place between both, both lofe, by the combination that enfues, fome of the qualities each feparately poffeffed.

This lofs of action excited, and this change of quality produced in each, are conftant and uniform, and fubfervient to the laws of phyfics in general. The laws of mechanics are defigned for the one, the laws of chemiftry for the other:—by the former, the motion of folids and

and fluids—of ſolids upon fluids—and finally of ſolids and fluids upon each other, either from impulſe, or difference in the ſpecific gravity in each, are regulated and aſcertained:—by the latter, not only the particular and individual qualities of matter of different kinds are diſcovered and explained, but likewiſe the different relations thoſe ſenſible properties bear to each other, with the ultimate reſult of the various compoſitions and decompoſitions they undergo: theſe phænomena, which common matter diſplays, are ſo regular and definite, ſo amenable to theſe fixed and general laws, that an experienced chemiſt can tell *à priori* the reſult that will conſequently enſue, provided the materials he employs are pure in their qualities.

With living matter it is far otherwiſe:—the general qualities it contains are not only totally different from the qualities of common, but the changes it undergoes: the infinite multitude of animated Beings we behold in the univerſe, the various faculties and powers they poſſeſs, prove that each ſyſtem, not only in its progreſs and its evolution, but in the various operations it performs, is governed by laws diſtinct and peculiar, dependent on the claſs to

which it belongs; and that the living matter of which it is compofed is totally different from common matter in a common ftate.

Every animated fyftem in its moft perfect condition is in perpetual action; it poffeffes the power either to refift the mechanical or chemical operation of common matter upon it, or to convert that common matter into a living ftate: I fay, it poffeffes the power to deftroy the fenfible properties of the fubftances expofed to its action, whilft it retains its own. A living fyftem not only acts to refift when it is *acted upon*, but it acts to convert and affimilate the objects upon which it operates, without being converted or even acted upon by them: it preferves its own integrity totally, and its various parts from decompofition and decay, whilft it acts upon things foreign to itfelf, and affimilates them to its own nature.

If the qualities (fenfible properties) be examined which thefe different fubftances obtain and affume, they will be found totally different from thofe they originally poffeffed. If faline fubftances have been introduced into the ftomach of a living animal, and there digefted, their fenfible or chemical properties are

are ſuſpended and loſt, and the order of their affinities is deſtroyed. If it be matter of a vegetable or of an animal kind, all veſtiges of its former qualities are obliterated, not only with reſpect to bulk and arrangement, but to the natural changes alſo to which it is prone, and which it ſpontaneouſly undergoes.

After vegetable or animal food has been digeſted by a living ſyſtem, the commutation it has ſuſtained is total and complete; it no longer retains the characteriſtic marks of the particular claſs to which it belonged; but it becomes expoſed to the ſame changes as the ſyſtem itſelf undergoes to which it has been applied, and is wholly amenable to its laws: the tendency to fermentation and putrefaction, to which vegetable and animal matter is prone, when it has been digeſted, is immediately checked; and finally, if it be common or inanimate matter, as water or air—as alcohol or acid:—matter, that, ſo far from having a tendency in its common ſtate to undergo the proceſſes of fermentation and putrefaction, digeſtion prevents theſe ultimate changes from taking place in animal or vegetable ſubſtances.

The inſtant theſe antiſeptic ſubſtances be-

come digefted, they lofe the old properties they before poffeffed, and acquire new; the property of preferving themfelves in a common ftate is loft, and they immediately become fufceptible and prone to undergo the feveral proceffes of putrefaction or of fermentation: fo that chyle, whether formed from fubftances the moft antifeptic and prefervative, from the moft putrefactive or fermentative, from alcohol or animal matter, from pure water or vegetable fubftances, from oxygene or azote, how different foever the fubject matter may have been out of which it had been conftituted, poffeffes the felf-fame general property of prefervation and tendency to putrefy or ferment.

Although the famenefs and unity of quality are regular and uniform, which thefe difcordant and different fubftances obtain by the digeftive power of every fyftem, there fubfifts a great and ftriking difference in the aptitude which different fubftances poffefs to be acted upon by different fyftems. Different fyftems require different kinds of food, as likewife the fame conftitution at different times.

When we contraft the variety that takes place

in the converſion of the different ſubſtances that are expoſed to the action of a living ſyſtem, we muſt neceſſarily be led to conclude that the effect produced is not the reſult of a chemical cauſe, or from the mutual action of different parts of the food upon each other. If it depended on a chemical cauſe, the changes which the food ſuſtained would be regular and conſtant; the chyle produced, inſtead of being the ſame, would be generally different; it would vary in its properties according to the qualities of the ſubſtances out of which it was formed; and finally, if it depended on the mutual action of different parts of the food upon each other, independent of the digeſtive power of the organ itſelf, the change it ſuſtained, like other chemical changes, would be conſtant and definite, and not liable to the remiſſion we witneſs during the proceſs of digeſtion.

The proceſs of digeſtion therefore, by means of which different kinds of food are aſſimilated into one kind, is not a chemical but a living act *: it is by virtue of this living

* *Hunter on the Blood*, p. 178. Our ideas of life have been

living power, which all animated beings poſſeſs, that they are capable of converting to their own nature the various ſubſtances on which they feed, and are made ultimately to aſſume the organization and form of the animated ſyſtem itſelf to which they are applied. Bread of the ſame preciſe quality, cut out of the ſame loaf, or water drawn from the ſame brook, given to a man or to a dog, after having been digeſted by the ſtomach of both, will contribute to the particular organization of each reſpective ſyſtem. We behold a multitude of vegetables nouriſhed and fed by water and air in quality the ſame,

been ſo much connected with organic bodies, and principally thoſe endowed with viſible action, that it requires a new bend to the mind to make it conceive that theſe circumſtances are not inſeparable. It is within theſe fifty years only that the callus of bone has been allowed to be alive; but organization and life do not depend in the leaſt on each other. Organization may ariſe out of living parts, and produce action; but life can never riſe out of or depend on organization: an organ is a peculiar but ſecondary matter (let that matter be what it may), to anſwer ſome purpoſe, the operation of which is mechanical: but ſuch mechaniſm can do nothing even in mechanics; it muſt ſtill have ſomething correſpondent to a living power, namely, ſome power elſe.

and

and yet aſſuming an organization and form totally different.

If the ſource of organization and of life therefore reſided in the food, every vegetable and every animal that fed upon the ſame materials would be faſhioned and modelled alike; for in all chemical and mechanical changes the ſame cauſes uniformly and invariably produce the ſame effects.

The evolution of a vegetable ſyſtem that takes place by the ſimple nouriſhment of water and of air, was a fact proved and aſcertained by Mr. Boyle as well as Dr. Hales: the ſame experiment has been repeated by different perſons, and the reſult found to correſpond. Mr. Abernethy ſtrewed the ſeeds of cabbages on thin clean flannel, ſpread on glazed earthen plates, and each day ſprinkled them with diſtilled water; the ſeeds ſoon began to vegetate, and the young plants grew as ſpeedily and vigorouſly as uſual.

Not only has vegetable life the power of elaborating a vegetable ſyſtem from air and water alone, but it appears that the ſame power reſides in the lower order of the animated creation. Dr. Fordyce encloſed ſeveral gold

and

and ſilver fiſh in glaſſes filled with common well water: he at firſt gave them freſh water every twenty-four hours, but latterly every three days: they continued to live and to grow for fifteen months without any further nouriſhment.

As it might have happened, that animalcules previouſly exiſted in the water, he took diſtilled water, and, adding air to it, carefully cloſed the veſſel to prevent the introduction of inſects: the fiſh however grew, and voided fæculent matter.

That the higher order of animals poſſeſs the ſame power, is proved by the whole of the herbivorous tribe who live on air and water, and on vegetables that are formed out of both. Mr. Abernethy procured a rabbit ſix weeks old, and fed him with a quantity of young cabbage and lettuce which grew on flannel, and were only ſprinkled with diſtilled water in the manner at firſt related: he mowed off the tops of theſe, and gave them to the animal: on the third day he appeared ill, and had a diarrhœa; a few ſhelled oats were given to him, with the former vegetables placed before him: the next day he was much better, and had

devoured

devoured both the oats and the greens: for four fucceeding days he ate plentifully of the frefh vegetables, and a fmall quantity of oats: although he was thin he appeared very lively; he ate altogether two ounces and a half of oats in one week – a very inadequate quantity to fupport him without the greens; but as he had confumed the whole ftock, the experiment could no longer be profecuted. Wheat in the decompofition is found not only to yield an amylaceous depofit, and a faccharine extract, but a fubftance exactly fimilar in its properties to animal gluten; and finally, Mr. Skinner has extracted from potatoes a large quantity of matter like animal albumen.

Since then it appears that the phænomena which every animated fyftem difplays, confute and contradict the hypothefis that fuppofes the fource of organization and of life to be refident in the food; it is lawful, and we are from neceffity led to conclude, that the commutation food obtains in the living fyftem, is a vital and not a chemical act, and that the efficient caufe of this commutation does not arife from any active property which the food contains, but is owing to the power of the

the ſyſtem in which it is received, and by which the new arrangement of its parts is formed *.

It is by the energy of this living power which the whole of the ſyſtem poſſeſſes, that it is preſerved in a ſtate of perfection, and reſiſts the operation of external cauſes; it is by virtue of the ſame power, eſpecially allotted to particular organs, that they are able to convert and aſſimilate the ſubſtances expoſed to their action, without ſuſtaining any loſs, or ſuffering in their fabric any læſion or alteration.

* Mat. Prior has ridiculed the idea of thoſe that thought life came out of the body inſtead of reſiding in it, by ſuppoſing that life was merely an effect of which organization was the cauſe.

"Note here Lucretius dares to teach
(As all our youth may learn from Creech)
That eyes were made, but could not view;
Nor hands embrace, nor feet purſue:
But heedleſs Nature did produce
The members firſt, and then the uſe.
What each muſt act was yet unknown,
Till all is mov'd by chance alone.

. . . .

Yet Poet and Philoſopher
Was he who durſt ſuch whims aver——
Bleſt, for his ſake, be human reaſon,
That came at all, tho' late in ſeaſon!"

When

When the affimilating organs perform their functions with efficacy and force, they poffefs the power of preferving themfelves and of retaining their own properties: they have the power to act without being acted upon, and to convert without being converted; they poffefs the power of changing and deftroying the fenfible or chemical qualities of the fubftances expofed to their action, whilft they retain their own organization perfect and unchanged: the quality of the matter acted upon and changed by the organ, bears no fimilitude to that which it originally poffeffed: inftead therefore of things external acting upon the living fyftem, it is the living fyftem that acts upon things external:—the fubftances therefore which are applied to the organ poffefs the aptitude * only to be acted upon and to be converted: thefe are the confequences that enfue when the living fyftem in the plenitude of health and of ftrength acts upon things external.

* Aptitude means, that peculiar difpofition in the internal arrangement of any fubftance, by which it becomes paffive to the action of an external organ:—thus the wax properly foftened poffeffes the aptitude to receive the impreffion from the feal.

Far

Far different indeed are the effects that are produced when things external act upon the living syſtem, when the organs have not the power of acting upon, or even reſiſting the action of, the ſubſtances they receive. The ingeſta either preſerve their own original properties, or they undergo the ſame chemical alteration in the ſyſtem itſelf, that they are prone to do out of it; the change and decompoſition they ſuſtain, and the new combinations that are formed, are regular and definite, depending on the chemical properties which the different ſubſtances poſſeſſed. Inſtead of animal or vegetable matter being converted into chyle, putrefaction and fermentation take place. If it be ſaline ſubſtances that are taken in for food, they obey the order of their affinities; the different parts enter into a chemical union with each other, and compound ſalts are formed. And finally, if the ſubſtances introduced poſſeſs any active chemical powers, as acids and alkali, they irritate and deſtroy the organization, and enter into a chemical union with the part, a decompoſition takes place, and a cauſtic effect is produced.

When

When the organs loſe their power of reſiſtance, their power of preſervation ſoon ceaſes: the ſyſtem therefore, inſtead of acting upon things foreign to itſelf, becomes acted upon by foreign things; inſtead of the power of life and aptitude, and the weakneſs of matter, it is the power of matter and the weakneſs of life; it is the chemical or mechanical property of common matter acting upon a living ſyſtem, in a periſhing and languiſhing ſtate, ſtruggling without force, and falling without reſiſtance; it therefore yields to the power by which it is aſſailed, it withers and decays, and the common or moribund phenomena of chemical union of fermentation or of putrefaction ultimately enſue.

It is to the power * by the energy of which

* Power has a two-fold ſignification: it is both the parent of energy, and the offſpring of it: for example, when the ſtomach has the *power* to digeſt and aſſimilate food, although it has not food to digeſt, it is then a dormant power. On the contrary, when this dormant power is in energy, in the act of digeſtion, inſtead of being power dormant, it is power active, imparting properties and powers to the ſubject on which it operates, of which that matter was deſtitute before: it is then the offspring of energy.

every

every living ſyſtem is protected and preſerved from decompoſition and decay, and by which the different ſubſtances it receives are aſſimilated and changed, that I attach the idea of *Life*; the Vis Medicatrix Naturæ of Stahl; the Vis Vitæ of Haller; the Niſus Formativus of Bluminbark; the Living Principle of Mr. Hunter; the Excitability of Dr. Brown, and finally, "the Form" of that excellent philoſopher Mr. Harris *.

It

* The learned Mr. Harris, a man who appears, according to my humble opinion, to have poſſeſſed a mind replete with the moſt ſublime conceptions, and which he applied to the objects of ſcience and of art, very juſtly ſays, as nothing can become known by that which it has not—ſo it would be *abſurd* to attempt deſcribing the *animating form* (*i. e.* a living principle) by any viſible or other qualities which are the *proper objects of our ſtudy*: the ſculptor's art is not figure, but it is that through which figure is imparted to ſomething elſe: the harper's art is not ſound, but it is that through which ſounds are called forth from ſomething elſe; they are of themſelves no object either of the ear or of the eye; but their nature or character is underſtood in this, that were they never to exert their proper energies on their *proper* ſubject, the marble would remain forever ſhapeleſs, the harp would remain forever ſilent.

It is the ſame in natural beings: the *animating form* of a natural

It is the prefiding principle which conftitutes the power of the fyftem; the bond of its elementary parts; the cement that connects them in one whole; it is the efficient and primary caufe, whence the individuality of every fyftem arifes, and in which the form it affumes effentially refides:—it is the power by which the human fpecies differs from the brute—the brute from the vegetable—the vegetable itfelf from formlefs and inanimate matter:—it is the caufe that this formlefs and inanimate matter is converted into organs living and active; and the various fpecies of matter this vital power receives are nothing more than the raw materials applied to it: it is the manufacturer that converts thefe materials without power or intelligence into different fyftems; and through which the acorn becomes evolved into an oak, the infant foliage expanded into leaves, and the final caufe of vegetable exiftence attained; it is

a natural body is neither its organization nor its figure, nor any of thofe inferior forms which make up the fyftem of its vifible qualities; but it is the power, which not being that organization nor thofe qualities, is yet able to produce, to preferve, and to employ them.

the

the caufe that the embryo becomes evolved out of matter in kind the fame, but modelling a fyftem conftituted of organs and of fluids in their kind and operation totally different: and finally, it is through the participation of this living power, which thefe organs and thefe fluids have received, that they become the means or the inftruments of its action; by which it accomplifhes the final caufe of its exiftence.—LIFE may therefore be defined—*the principle* (i. e. *the efficient and primary caufe*) *by the energy of which various fpecies of matter are converted to one kind under one fyftem, fo that the matter thus converted poffeffes the power of refifting the operation of external caufes, and of preferving itfelf from decompofition and decay.*

The living principle therefore conftitutes the very effence of the various animated fyftems we behold, fince it was by the energy of its power that they were fafhioned and formed, and by which they are characterized and preferved: fo long therefore as the matter of which they are compofed continues to preferve the identity and integrity of its character, I conceive that it proceeds from the energy of the

the power by which it was affimilated and organized, and that power I call *Life*. The matter itfelf which has received the participation of this living power, I call living matter; in contradiftinction to matter either dead or common.

Life therefore exifts in all animal and vegetable matter in a ftate of prefervation, and abfolute death is only prefent in animal and vegetable matter in a ftate of putrefaction and fermentation: the power of prefervation and refiftance exifts until thefe changes have taken place: after this power departs, diffolution and decay immediately and finally enfue: the whole feparates into parts; the oak and the chaff, the body of the philofopher and of the reptile crumble into duft, and return to the different elements the various materials which the living principle had employed in compofition and organization.

It is very evident to me, that phyfiologifts, by their ignorance of the nature of life, have miftaken the caufe and nature of death; they have looked for the exiftence of life in the energy it occafionally difplays in organic action only; and have erroneoufly fuppofed,

 that

that when the phænomena of organic action ceafed, the power of life expired, and this organized matter became virtually and actually dead: they have been led into this error, by confounding inftead of feparating the common and general properties of living matter from thofe that are particular and diftinct; they have overlooked the power of prefervation, which is effentially neceffary to characterize living matter from that which is dead or common; it is therefore proper to afcertain, in order that we may be able to feparate, the different property of prefervation in general from that of organic action in particular.

CHAP.

CHAP. II.

THE PROPERTIES OF LIVING AND DEAD MATTER.

The properties of living matter are general and particular—the one is materia vitæ diffuſa, the other materia vitæ coacervata—the former often active, whilſt the other is dormant—that the ceſſation of its powers does not produce death, is proved by facts—abſolute death produced by decompoſition alone.

THE principle of Life is diffuſed throughout the whole of the ſyſtem, and is common to every part: no part of which that ſyſtem is conſtituted and compoſed, is dead ſo long as it continues to preſerve the participation and energy of that living principle which it has received, and which Mr. Hunter has erroneouſly called the *materia vitæ diffuſa*, inſtead of *principium vitæ diffuſum*. The *materia vitæ diffuſa* is an effect only of which the *principium vitæ* is the cauſe: the *principium vitæ* is the power; the *materia vitæ* is the energy of that power. Although every part of the ſyſtem poſſeſſes this *principium vitæ diffuſum*, by the energy of which the *materia vitæ diffuſa* is produced, and which is common to the whole,

 particular

particular parts poſſeſs particular powers which are individual and diſtinct, and by which we behold the ſpecific effect of organic action. For example: the ſtomach, the liver, the eye, and every other organ, poſſeſs the participation of the principle of Life in common with every other part: but beſides this power common to the whole, the ſtomach poſſeſſes the particular and diſtinct power to aſſimilate the food it receives, the liver to convert blood into bile, and the eye to convey to the mind through the medium of the optic nerves the impreſſion it receives from without.

It does not however follow, that becauſe theſe particular powers, which the organs in general poſſeſs, are either ſuſpended or even loſt, that they have loſt alſo the living and preſervative power common to the whole ſyſtem: the *materia vitæ coacervata* is frequently dormant, or has vaniſhed, whilſt the *materia vitæ diffuſa* is active, and in full vigour: the ſtomach is not dead becauſe it does not aſſimilate the food it receives; the liver, becauſe it does not convert the blood conveyed to it by the *vena portæ* into bile; nor the eye, becauſe it does not convey to the ſentient principle

ciple the rays of light which it receives. In the *gutta ſerena*, although the rays of light are applied to the optic nerve, the action of viſion does not enſue; and yet the optic nerve is alive: if it were dead, it would putrefy and decompoſe like all mortified parts. Theſe powers are ſuperadded to theſe organs, and theſe organs often loſe the energy of theſe particular powers, whilſt they retain thoſe that are preſervative and general.

The exiſtence of theſe preſervative and general powers is apparent, whilſt thoſe that are particular or dormant are loſt, in the whole vegetable and animal creation: it is proved in the ſeeds of plants and in the grafting of trees. A potatoe, after having been kept out of the ground for eight or nine months, or the ſeed of a melon for eighty or ninety years, poſſeſſes the power of preſervation for the whole of that long period; and they would either remain in a torpid ſtate, or crumble to decay, unleſs they were placed in ſituations fitted for the action of the living principle they contained. As ſoon as theſe ſeeds are placed in media fitted for their action, and which poſſeſs an aptitude to be acted upon

by it, the living principle becomes roufed from its dormant ftate into energy and action; a general evolution of that living power on external fubftances takes place, by which the perfection of their refpective fyftems was produced. We all know the neceffity of heat for the purpofe of incubation; of heat, of moifture, and of air, for the production of vegetation: thefe various fubftances are converted by the living principle of the vegetable into its own kind, in the fame manner as food is digefted in the human ftomach by the living power of the gaftric juice. Life therefore may and does exift without organic action, but organic action cannot exift without life.

It is by virtue of this living power that vegetation continues in different kinds of fruits, after having been feparated from the trees on which they grew; that oranges and lemons, gathered in tropical climates young and unripe, continue to vegetate, and to arrive at maturity and perfection on their paffage to this country. Can it be pretended that the mere feparation of the fruit from the tree, or the mere divifion of the orange or the apple into parts, deftroys its life, and conftitutes the immediate and ab-

folute

ſolute death of the whole? On the contrary, it is far more reaſonable to conclude, that its preſervative power is diminiſhed, and its tendency to putrefaction and decay conſequently increaſed: and, finally, this preſervative power is evinced by the whole vegetable world, in the winter, when it ſubſiſts in a living, although in a torpid ſtate, when the action of the *materia vitæ coacervata* is totally ſuſpended, although the action of the *materia vitæ diffuſa* continues.

It is proved, in the animal kingdom, by facts equally obvious and ſtriking; by the preſervative property which eggs contain; by the tranſplanting of teeth; by the transfuſion of the blood; and by torpid animals in a torpid ſtate. It is proved by the *fœtus in utero*, whoſe different organic actions are in a dormant ſtate, although the general property of preſervation common to the whole exiſts in a moſt eminent degree: and it is proved by the action of particular parts of particular animals: the heart of a turtle or of a frog will retain its irritability and power of contraction for ſeveral days after it has been completely cut or torn out from the ſyſtem to which it belonged; not a part alone, but the whole animal

animal altogether may be frozen nearly to a ſtate of petrifaction, and ſtill retain its preſervative power; the different organs recover their particular action after they have been thawed by the gradual application of heat, and the whole animal is as vivacious as before. Neither the deprivation of heat, the ſuſpenſion of reſpiration, or even the læſion of parts, when any of theſe either exiſt ſeparately or the whole together, prove the total deprivation of life: there is evidently a ceſſation of organic action, but the power of preſervation ſtill continues to ſubſiſt; ſo that an apple, or a junk of meat, when they are bruiſed, and the diſpoſition of their parts has been altered and deranged, become ſooner acted upon, and ſooner rot and putrefy, than where they have not ſuffered ſuch violence.

It is very common, indeed, for organs to loſe their organic powers, and to recover them completely, as in the paralyſis of particular parts, and where the duration of Life is very apparent *.

If

* No doubt can ſubſiſt that the moſt active and vigorous organ of the moſt ſalacious animal, although it retains

If we are to credit the accounts publiſhed by the Humane Society, ſpecific organic action has been reſuſcitated after it had been ſuſpended for many hours, and while the following torpid ſtate was preſent—the rigid limb, the clay cold ſkin, the ſilent pulſe, the breathleſs lip, the livid cheek, the fallen jaw, the pinched noſtril, and the fixed ſtaring eye; and, finally, various inſtances are recorded by the venerable authors of antiquity, where organic action had been recovered after it had been ſuſpended for ſeveral days. Celſus relates ſeveral caſes of this kind; and there are, perhaps, very few authorities more to be depended upon than that of this great man. Without truſting to human teſtimony alone, we have alſo that which is divine. I only mean what reſpects the diſtinction between apparent and abſolute death; for the recovery of action in all the caſes related was miraculous, effected by the almighty power alone of the great Author of our Salvation.

I might ſtate the caſe of Jairus's daughter,

tains its preſervative properties, is in a paralytic ſtate at particular ſeaſons of every age, and at all ſeaſons at the period of old age.

mentioned

mentioned by St. Luke. She was twelve years old when Jairus firft applied to Jefus; "fhe "lay a-dying:" but foon after fhe was fo dead that the ruler of the fynagogue told him "not "to trouble his mafter." All, therefore, wept and bewailed her: but Jefus faid, "Weep not, "fhe is not dead, but fleepeth." They laughed him to fcorn, knowing that fhe was dead: and he put them all out, and took her by the hand, and called, faying, "Maid, arife;" and her fpirit came again, and fhe arofe ftraightway. Here then was a cafe of fufpenfion of all organic action, whilft the power of prefervation fubfifted. We have fimilar inftances related in the book of Kings, of the prophet Elijah reviving the widow's fon, and of our Lord himfelf, when he reanimated the widow of Nain's fon.

On the contrary, when the Evangelift fpeaks of death, he makes a very evident diftinction between the figns by which it is characterifed and thofe that attend fufpended animation only; as in the cafe of Lazarus, who had been dead four days, and "*that he* "*ftinketh.*" Here then we find in fcripture itfelf an evident diftinction between the mere fufpenfion of organic action, whilft the general

properties

properties of prefervation continue to fubfift, and the total deprivation of Life with the confequent lofs of all organic power.

It is impoffible for any part to recover its fpecific power when once the powers of prefervation are loft by the effects of decompofition: the former is particular, and only occafionally employed; the latter never ceafes its work without deftruction enfuing to every part. It therefore does not follow that organs are abfolutely dead becaufe they do not act, or even becaufe they have loft their power of action when the ftimulus is applied which is proper to excite them to act.

If the definition of life were to be taken from this fource, from the difpofition that parts have to act on the application of a ftimulus, fuch a definition would apply to the nature of common rather than of living matter, after that common matter has been excited into action. It is then that we behold capacity only, and not power: common matter has the capacity of being moved only, without the power of moving itfelf: on the contrary, a living fyftem has the power of moving itfelf, and the capacity of refifting motion which it externally receives.

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The whole phenomena which common matter difplays, are illuftrative of this principle: thus we find, that a fpring has the capacity of being moved, and of re-acting when it is acted upon, but that it is deftitute of any power of moving itfelf: a ftone has the capacity of being moved when a projectile force is applied to it: both move when the ftimulus is applied, and yet neither of them is alive: on the contrary, we find various organs that are not dead, although they have loft all difpofition to particular action: they remain in a torpid ftate, notwithftanding the ftimulus is applied that is neceffary to excite them to act.

Since then it appears what life and living matter are; to underftand what life is not, and living matter is not, muft be moft obvious and plain. Life does not exift in any part of the elementary matter of which the univerfe is compofed; not in earth, or in metals, not in water, or in the different fpecies of air, when they fubfift in a common ftate: neither is life prefent in any of the excretions either of an animal or vegetable fyftem, nor in any animal or vegetable matter in a ftate of putrefaction or fermentation. Putrefaction and fermentation arife from the deprivation of life in matter which has been once

once vivified, and which constitutes its dissolution or death. Dead matter therefore differs from common matter in this respect: the one has been vivified by having received the participation of life, and it is suffering the ultimate deprivation of the living power which it had received, by the processes of putrefaction or fermentation: these are the means by which it is finally and completely resolved from a dead to a common state; the other is not susceptible, of itself, to undergo the processes of putrefaction or fermentation, but is perpetually disposed to remain in a passive condition.

Speaking therefore the language of physiologists, we are to separate the suspension or deprivation of organic action, whilst the powers of preservation remain, from the total abolition of action that arises from the state of decomposition: from a state of preservation and perfection, the change takes place of imperfection verging to decay: between health and death disease exists; between death and actual dissolution, decomposition intervenes: the different periods of time which animals of different species, or different parts of animals of the same species, take to decompose and putrefy,

trefy, evidently prove, that this preſervative power is ſtronger in ſome claſſes, and weaker in others, as well as in particular parts of which they are compoſed; and that thoſe parts are more eaſily acted upon by external ſubſtances, with which they unite and chemically combine: the new combinations that enſue, can only ariſe from a loſs of aptitude in the parts to retain the participation of the living principle which they had received: it is by the loſs of the one that they acquire the tendency of forming the other. Although there is a difference in time, it is the fate allotted to all generated beings, and to which they are doomed. They are eſſentially tranſient and frail, and in a conſtant ſtate of progreſſion, perfection or decay.

Whenever the period arrives wherein the energy of the vital principle upon common matter ends, the energy of nature upon living matter begins*; and as the principle of life acted upon common matter to make it living, ſo nature acts upon living matter to make it common: the energy of the one tends to unite,

* What nature is will be particularly mentioned at the concluſion of the work, when we treat of the decompoſition of animal and vegetable matter.

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the province of the latter is to ſeparate. Putrefaction and fermentation are the means which nature employs to produce this ſeparation, by which the bond of vegetable and of animal matter becomes looſened and broke; the ſyſtem itſelf becomes develated from an organized into a diſorganized ſtate, and brought from a living into a dead one. The parts that were fixed become volatile; ſuch as were inodorous become offenſive to the olfactory ſenſe; ſuch as were inſipid become ſapid; thoſe that were homogeneous become heterogeneous; parts that were active become paſſive, and loſe all irritability on the application of ſtimuli; and, finally, the whole becomes reſolved into a common ſtate.

Putrefaction and fermentation have the ſame relation to death that the act of digeſtion has to life: the act of digeſtion prepares common and inanimate matter to receive the influence of the living principle of the ſyſtem to which it is applied: on the contrary, putrefaction and fermentation bring back living matter to a common ſtate: it is the laſt and ultimate change it ſuſtains, and which alone virtually, and in fact, conſtitutes death; not

a ſuſpenſion of organic action only, but a total decompoſition from the ſtate of union it was in before.

The fleſh of a horſe or of an aſs, of a monkey or of a man, of a materialiſt or of a philoſopher, yields preciſely the ſame product by decompoſition: there may, perhaps, be a little more volatile alkali in the one than in the other; but as this difference is frequently found in the analyſis of the fleſh of different men, no inference can from thence be drawn that the animal matter of which theſe different beings are compoſed is eſſentially different.

The matter indeed which is decompoſed, may vary in its properties, and aſſume different forms; the azote may differently combine with the carbone, the animal gluten with the ſerum, the craſſamentum with the animal gluten; and different compounds may be in conſequence produced.

Theſe effects, however, regularly and uniformly enſue between ſubſtances of this kind placed under the like circumſtances; they are chemical changes, ſubject to chemical laws, which theſe bodies ſuſtain, either of union or of ſeparation, of re-combination or of diſ-

perſion,

perſion, dependent on the various ſenſible qualities they poſſeſs: decompoſition is the laſt change they ſuſtain before they are ultimately and completely reſolved into a common ſtate, and which common matter in a common ſtate is not able to undergo.

Common matter therefore, in a common ſtate, with relation to the principle of life, or the matter it has animated, appears to be nothing more than quantity alone, with the attributes of reſiſtance, and of extenſion into length, breadth, and thickneſs—diviſible in all its parts, and therefore totally imbecile and inert—poſſeſſing nothing elſe than univerſal privation—privation of every quality whatever—and therefore containing the univerſal capacity of being the univerſal recipient for all qualities which the energy of life may impart.

CHAP. III.

OF COMMON MATTER.

With relation to life, *common matter is destitute of all power:—if it possessed power, it would act:—if it retained its sensible qualities, whether of figure or colour, &c. these qualities would be imparted to the living system, and deformity produced—the living system therefore destroys the sensible qualities of common matter, and makes it subsist in a state of total privation—out of this total privation it is that its aptitude arises to be modelled and organized. This idea of common matter, conformable to Mr. Harris's opinion, and to Bishop Berkeley.*

IT is in this negative state of subsistence, in this universal privation of all sensible qualities with respect to the vital principle, or to the assimilating organ, which every animated system contains, that matter possesses an universal aptitude to be acted upon, to have its elementary parts changed, to have new arrangements formed, and have qualities imparted to it, of which it is originally and naturally destitute.

If

If the food which any living fyftem receives for nourifhment and fupport, acted by virtue of its fenfible qualities, whether of folidity or figure, of colour or of odour; thofe qualities would refift the operation, and prevent the efficacy, of thofe it was intended to receive, and which the powers of Life are defigned to convey.

If it poffeffed any permanent power of folidity, it could not be diffolved: if it poffeffed any permanent figure, that figure would be conftantly apparent, and the matter received could not be fafhioned and formed into the different parts for which it was defigned.

If any permanent colour, that colour would be imparted to the blood, and the lineaments and tints of the fyftem become in confequence affected, different from what is natural and proper: if it were madder, it would impart a red; if turmerick or bile, a yellow colour to the whole frame.

It is with a view of deftroying the fenfible qualities which different living fyftems receive, that their affimilating organs are efpecially defigned; they are defigned to reduce fubftances

of different kinds to one—that this one ſubſtance may be in harmony with the ſyſtem, and be fitted to be acted upon, and converted by the ſpecific power of different organs into various ſhapes.

The aptitude, therefore, of the matter which every living ſyſtem receives can only ariſe out of its weakneſs or total privation: it is in this deſtitute ſtate that we ſay matter is imbecile and inert, a mere *tabula raſa*, void of all power and of all intelligence.

Matter, therefore, has the aptitude (or capacity, for both mean the ſame) of being acted upon, without the power of reſiſting action: it has the capacity of being changed, without the power of changing; of being modelled, without the power of modelling: this relation of power and of aptitude is illuſtrated in the various works of art.

It is by the power of the artiſt that the marble is chiſeled into the ſtatue, the iron into the ſaw, the timber into the ſhip: it is more eſpecially evident in the works of animated creation: it is by the power which living beings poſſeſs, that water and air are changed

changed into the various animal and vegetable ſyſtems we behold, and with which the univerſe is repleniſhed and adorned.

This capacity of being changed, which matter contains, is a capacity of weakneſs (if I may ſo ſay), in contradiſtinction to the power and energy which every living principle eſſentially poſſeſſes.

The power which every living ſyſtem poſſeſſes, is manifeſted by the energy it diſplays in acting upon the aptitude which matter retains, and which I have above deſcribed: it acts, to change this matter from a dead into a living ſtate, from a ſtate of diſperſion into a ſtate of combination, from a ſtate of chaos into ſymmetry and order, from a mere *tabula raſa* into organization and form, from a multitude of parts into a whole, which we behold every animated ſyſtem ſo eminently contain.

Matter bears the ſame relation to the living principle by which it is converted, as the materials which are faſhioned and formed by the art and power of the artiſt; as a ſervant to his maſter, as a pupil to his teacher, as children to their parents, as ſubjects to their ſovereign

 ſupreme,

ſupreme, or as the univerſe in general to the Deity Omnipotent, by whoſe infinite power it is governed and controlled. It is in this relation that ſubſiſts between the active and the paſſive, the ſtrong and the weak, that we behold the regularity that prevails in every part of the whole.

Mr. Harris, therefore, very properly defines matter to be that elementary conſtituent in compoſite ſubſtances which appertains in common to them all, without diſtinguiſhing them from one another; for although the matter of which the temple and the palace, the ark and the ſhip, the anvil and the ſaw, are formed, may be in kind ſeverally the ſame, and appertain in common to them all, it does not diſtinguiſh the one from the other: they are diſtinguiſhed from one another by the energy of the formative power, by which matter the ſame in kind is formed into inſtruments totally different: this power does not reſide in the matter, but proceeds either from the art of the mechanic by which it was modelled, or from the power of the living principle by which it was organized. It is this to which Mr. Harris has given the appellation of pri-

mary

mary matter, the ὑλη πρωτη of the ancients; the *ſubſtratum* of all compoſite ſubſtances of which they are conſtituted; without, however, giving thoſe ſubſtances any diſtinction, or any character; a mere chaos, a *rudis indigeſtaque moles.*

Mr. Harris conceives, that the firſt and moſt general character which this primary matter aſſumes is that of form, by means of which every compoſite ſubſtance is diſtinguiſhed and characterized; that the firſt and moſt ſimple extenſion is a line: that this, when it exiſts united with a ſecond extenſion, makes a ſuperficies, and theſe two exiſting together make a ſolid. Now, then, this laſt and complete extenſion we call the firſt and ſimpleſt form or quality which body aſſumes; and when this firſt and ſimpleſt form accedes to this firſt and ſimple matter, the union of theſe two (matter and form) produces body, which is therefore defined to be matter triply extended, and the manner in which this extended body is bounded is called figure. If animated, the mode in which the parts of which it is compoſed are arranged, is called its organization; and if inanimate, it is called its ſenſible or ſecondary

condary properties. It is very probable that the various ſenſible qualities which chemical ſubſtances aſſume may ariſe from the peculiarity in the arrangement of their primary particles, ſuch as hardneſs and ſoftneſs, roughneſs and ſmoothneſs, the tribes of colours, ſavours and odours, on which the phænomena of magnetiſm, electricity, attraction, and repulſion depend. As the conſideration, however, of theſe qualities becomes the more immediate province of the chemiſt, I muſt defer the conſideration of them to the concluſion of this work, when the duty of the phyſiologiſt ends, and that of the chemiſt begins, when the loſs of life ſuffers a decompoſition to take place, by which matter conſequently recovers the various ſenſible properties it originally poſſeſſed.

I ſhall merely confine myſelf to obſerve, that this opinion, with reſpect to matter, exactly accords with thoſe that were entertained by that great man Dr. Berkeley, biſhop of Cloyne. So convinced was he of the total indigence and inertneſs of its nature, that he has been falſely accuſed of having even denied its exiſtence. He admitted its exiſtence, but

denied its power: he ſuppoſed it to be the recipient only of active powers, but that it was of itſelf totally imbecile and inert.

Theſe powers he explains to be either thoſe of nature or of life; but he refuted, as abſurd, and diſclaimed the idea of thoſe who ſuppoſed that matter, either in the groſs or in its particles, poſſeſſed any inherent or eſſential powers whatever: "we are not," ſays he, "ſeriouſly to ſuppoſe, with certain mechanic philoſophers, that the minute particles of bodies have real force or powers, by which they act on each other, to produce the various phænomena of nature.

"The minuteſt particles are impelled or directed according to various rules of motion: but we are not at all concerned about the forces; neither can we know or meaſure them any otherwiſe than by their effect. The material or mechanic philoſopher endeavours to find theſe laws by experiment and reaſoning: but what is ſaid of forces reſiding in bodies, whether attracting or repelling, is to be regarded only as a mathematical hypotheſis, and not as any thing really exiſting in nature.

"Again: Body, ſays he, is oppoſite to ſpirit

or

or mind: we have a notion of ſpirit from thought and action: we have a notion of body from reſiſtance: where there is real power there is ſpirit: where there is reſiſtance, there is inability or want of power; that is, there is a negation of ſpirit: we are therefore impeded and clogged by weight, and hindered by reſiſtance: natural phænomena are only natural appearances and effects: they are paſſive, without any thing active; fluent and changing, without any thing permanent in them."

That matter has the capacity of being divided *ad infinitum*, appears to me to be demonſtrable. If a ſtick be divided into two, half will remain; and this half has ſtill the capacity of being divided for ever. I do not mean to ſay that the limited power of any one can produce this infinite effect. I mean, that the ſubject matter only has the capacity of being ſo divided: this infinite capacity which it poſſeſſes, ariſes from its indefinite nature, the ſource of boundleſs diffuſion and innumerable multitude.

This property of matter has been admitted by ſome, and denied by others. I ſhall quote the

the Rev. Mr. Jones's opinion upon the ſubject, although it differs from my own: it is the opinion of a man, whoſe eminent abilities, and the manner in which they are diſplayed, entitle him to the admiration and praiſe of the age and country in which he lives.

" The parts of matter, ſays he, may be di-
" vided from each other without any limits
" which we are able to determine: we may
" therefore allow that matter is indefinitely
" diviſible; but if we ſhould affirm it to be
" infinitely diviſible, we ſhall have ſome mon-
" ſtrous abſurdities to encounter. Suppoſe
" there are two maſſes of matter, A and B,
" and that B is equal to twice A. If the parts
" of both theſe maſſes are infinite in number,
" then one of theſe two conſequences muſt
" follow; either that the leſs is equal to the
" greater, and ſo a part equal to the whole;
" or that we have two infinites, one of which
" is but a part of the other; which is contrary
" to all ideas we have of infinity. So again, if
" the whole is finite, while the parts are in-
" finite, it muſt follow, that the parts are
" greater than the whole; or, which comes to
" the

" the ſame, that parts infinite in number will " compoſe an whole that is finite.

" It is impoſſible to imagine the parts of " matter ſo far divided, but that numbers may " be applied to meaſure them, becauſe we can " increaſe numbers in our imagination as faſt " and as far as we can divide the parts of mat- " ter: hence it will follow, that the parts can- " not be finite, becauſe this will infer the ne- " ceſſity of one infinite number; which is an " abſurdity, becauſe it is a number to which " you cannot add one *."

* Vide Phyſiological Diſquiſitions.

CHAP.

CHAP. IV.

OF THE MATERIALIST.

The doctrine ſtated—proved to be erroneous from the imbecility of matter—The chemical changes it undergoes definite and limited—unable to convert itſelf into organs which poſſeſs various powers.—Dr. Prieſtley's opinion refuted by Dr. Price—An examination into the particular phænomena diſplayed by common and living matter—and the reſult proved, that the one is totally oppoſite and contrary to the other.

THIS vague and indefinite nature of matter itſelf—the paſſive condition to which it is diſpoſed—the circumſcribed and regular changes it is made occaſionally to ſuſtain, have not however prevented a ſet of pretended philoſophers, who debaſe the name they aſſume, by the appellation of materialiſts, from aſcribing to matter powers of which I have proved it is wholly deſtitute: they contend, that all matter, however groſs, however imbecile and inert, eſſentially contains certain powers of attraction and repulſion:

repulſion: that, by virtue of theſe powers, matter can convert itſelf into different organs; in fabric moſt delicate, in action moſt extenſive, in form moſt diverſified: that by the congregation of thoſe organs a whole ſyſtem is conſtituted: that the reſult of this organization is life; and out of this organized life action and motion are produced; ſo that matter is the efficient cauſe, and life only the effect.

The grounds of theſe opinions have been already refuted as falſe, when I pointed out the univerſal and definite changes which all dead or common matter underwent, when placed under ſimilar circumſtances, and expoſed to the operation of cauſes the ſame in kind; and finally, of the uniform capacity it contained of remaining in a paſſive ſtate, unleſs it was acted upon by agents external to itſelf.

They were, I conceive, proved to be abſurd, when we beheld the infinite difference, matter the ſame in kind aſſumed when expoſed to the action of different living ſyſtems, and the weakneſs it poſſeſſed to preſerve the paſſive and formleſs ſtate to which it was conſigned: it therefore yielded to the living power by

which it was affailed: it became acted upon by it: it became modified and changed, organized and arranged without any oppofing power of its own.

Nothing elfe than a crooked zigzag way of thinking could have led thefe *philofophers* to have afcribed to matter, independent of the participation of life, the power of organization, and to this organization the fource of life as its caufe. It is evident indeed, that thefe gentlemen move in an inverted order, and end where they fhould begin: they make power to arife out of weaknefs; fymmetry and order from that which is effentially formlefs and motionlefs; and, finally, defign and intelligence, the attribute of things void of all confcioufnefs and deftitute of all fenfation. Inftead of making organization the effect of life, they make life the effect of organization: inftead of making the phænomenon of organization the final, they make it the efficient caufe in which life is fuppofed truly and virtually to confift. The falfe views of things which men of diftinguifhed talents have taken, are to me a fubject of melancholy reflection: the doctrine of the materialift was broached by fome clever men long before Dr.

Prieftley's time; and we have feen it propagated by many foolifh men after him, and fuffered to pafs current down to the prefent moment: they beheld every where living fyftems connected with an arrangement of parts, and that this arrangement was abfolutely neceffary to the actions they performed: they therefore juftly concluded that their actions were the confequence or the effect of this arrangement and organization: they faw the final caufe (*i. e.* the action) immediately arife from the inftrumental caufe (*i. e.* the organization): they refted fatisfied with attributing the whole power to the organization alone, and enquired no farther: they never enquired how that arrangement was formed, and by what power it was produced*.

Had

* Dr. Prieftley, however, being forced to admit "that "matter itfelf had not the power of producing the phænomena he beheld, was led to afcribe them to imaginary "powers of attraction and of repulfion it contained. "Suppofe," fays he, "that the Divine Being, when he "created matter, only fixed certain centres of various "attractions and repulfions, extending indefinitely in "all directions, the whole effect of them to be upon "each other; thefe centres approaching to or receding "from each other, and confequently carrying their pecu- "liar

Had they inveftigated this fubject as phyfiologifts not chemifts, as metaphyficians not materialifts; they would have feen, that although the action was an effect of which organization was the caufe, yet that the organization itfelf was an effect only of which the principle of life was the primary and efficient

" liar fpheres of attraction and of repulfion along with " them, according to certain definite circumftances. It " cannot be denied that thefe fpheres may be diverfified " infinitely, fo as to correfpond to all the kinds of bodies " we are acquainted with, or that are poffible; for all " effects in which bodies are concerned, and of which we " can be fenfible by our eyes, touch, &c. may be refolved " into attraction and repulfion, &c. &c." The Doctor, however, by this falfe hypothefis, is led utimately to conclude, " that matter is not impenetrable, or effentially " folid, and that fuch a fuppofition is deftitute of all fup- " port whatever; and that exclufive of attraction and of " repulfion, it is abfolutely nothing, and that feveral " fpheres of them placed within one another conftitute a " body that we term compact, &c." Dr. Price, however, very quaintly afks, " What is it that attracts and repels, " and that is attracted and repelled?" but he afked in vain. He therefore goes on to obferve, that " fince it is affirmed, " that, exclufive of attraction and of repulfion, matter is " abfolutely nothing; and therefore, though we were to " allow it the power of attracting and repelling, yet, as " it is nothing but this power, it muft be the power of " nothing, and the very idea of it be a contradiction."

 caufe

caufe, in which the fource and power of action effentially refided: that this primary caufe conftituted the power by which the organization was firft produced: that in its effence it was active, and the matter upon which it operated was paffive; and that the matter of which the organs were compofed, and therefore the organs themfelves, were merely the inftruments of its power, and fubfervient to its laws. The various fyftems therefore we behold, are the effects only of powers which we do not fee; they are the external and fenfible organs modelled and formed by the principle which is invifible to our fenfes: in its nature it is not material; becaufe the operation of matter is regular and definite, fuffering only chemical or mechanical changes: it cannot be the attribute of any material fubftance inert and weak: it muft therefore belong to a principle effentially active, and therefore of an incorporeal and immaterial nature; by the energy of which, matter formlefs and motionlefs becomes organized, and made to poffefs the power of motion, and of producing the various phænomena it difplays.

To put the matter beyond the power of controverfy

controverſy or of doubt, I ſhall endeavour to diſcriminate the reſpective properties of matter dead and paſſive, from thoſe that are living and active; and, in the firſt place, examine and compare the conſequences that enſue in both, by the application to each of mechanical powers in kind the ſame.

In common matter, an increaſe of bulk is invariably produced in proportion to the quantity of matter applied; in a living ſyſtem, no addition of matter can produce an increaſe, when once it has attained the full perfection of its evolution. The increaſe of bulk, in common matter, comes by accretion from without; in the living ſyſtem, it proceeds by converſion and ſecretion from within: in the firſt, the maſs is irregular and diſordered (*rudis indigeſtaque moles*); in the ſecond, the parts are diſpoſed and arranged with the moſt exquiſite ſymmetry.

Every addition which a maſs of common matter ſuſtains is from above—below: in the vegetable ſyſtem the order is reverſed; the addition is from below; and the evolution proceeds not only from below upwards, but in all directions; and, in the more compli-

cated ſyſtems, the blood is conveyed as perfectly to the ſuperior as to the inferior parts of the body, and returned as perfectly from the lower to the upper parts, without any additional power in the veſſel by which it is contained: the former, unleſs diſturbed by the concuſſion of the elements, or the art of man, continue permanently the ſame through the long courſe of revolving ages; the latter, after having attained their period of perfection, are perpetually verging to decay.

If the action of any inanimate machine be examined, and compared with the mechanical actions that flow from a living ſyſtem, we ſhall find the ſame difference to ſubſiſt: in the firſt, the motion that takes place in conſequence of the preſſure of fluids upon ſolids, or of ſolids upon each other, however ſmall that preſſure may be, is conſtantly attended with mechanical deſtruction, and loſs of ſubſtance: in the living ſyſtem, inſtead of a waſte being produced by a moderate preſſure, an increaſe of ſubſtance generally enſues: in the one, the waſte is conſtantly in proportion to the degree of motion produced, and preſſure ſuſtained, whether in a watch or in a mill, in

a ſhoe

a ſhoe or in a glove; in the other there is an increaſe of bulk and of power in thoſe parts of the ſyſtem that are moſt expoſed to preſſure and to motion. The thickneſs in the ſkin of the feet and hands, the increaſed ſize and ſtrength in the muſcles of the active and laborious, all prove the difference that exiſts between the operation of external cauſes, on an inanimate machine and a living ſyſtem; whilſt the very ſhoes we wear progreſſively grow thin and weak, in proportion to the friction they ſuſtain; the cuticle and cutis progreſſively grow turgid and ſtrong: ſo far, therefore from preſſure producing a loſs, it cauſes an increaſe; and inſtead of weakneſs being cauſed by action, action contributes to the acquiſition of ſtrength.

If the negative compariſon be made between both, the ſame contrariety will be found to ſubſiſt: when the motion of any inanimate machine is made to ceaſe, the waſte it ſuſtained by virtue of thoſe motions ends— and the whole continues unalterably the ſame (if the materials are good, the watch of the laſt century is the ſame as this): on the contrary, in the living ſyſtem, the muſcles and

other parts that had increaſed in ſize and ſtrength in conſequence of increaſed action, are found to diminiſh and waſte when thoſe actions have been reduced and diſcontinued.

The inertneſs and imbecility of inanimate machines render them totally deſtitute of the power either of preſerving themſelves in a ſtate of perfection, or of reſtoring the loſs they ſuffer by the action they undergo: the banks of a river therefore perpetually crumble and waſte by the friction of the ſtream. With living ſyſtems it is far otherwiſe: they poſſeſs powers not only of preſervation, but of reſtoration in every part: ſo far from a waſte or decay of the arteries and veins being produced by the motion of the blood they contain, that they become proportionably ſolid and ſtrong by the duration of the friction they ſuſtain: theſe veſſels are relatively weaker in the young than in the old; as is proved by the frequent occurrence of epiſtaxis and of hæmoptoe: they are harder in the old than in the young; as is proved by the frequent exiſtence of oſſification of different parts of the vaſcular ſyſtem, and the abſence of hæmorrhage.

The power which every animated ſyſtem

eſſentially

effentially contains of prefervation and of refiftance, extends to the influence of climate, to the temperature of the air, and to the chemical operation of various fubftances. Let us in the firft place examine the effects which atmofpheric air produces, in a mafs of common matter, and in an animated fyftem: the action of atmofpheric air on common matter arifes from without, and penetrates within; the action of vital air in the animated fyftem is converted by a power from within, and is conveyed throughout its various parts: in the firft, the different parts of which atmofpheric air is compofed, come in combination with the fubftance to which it is applied; in the fecond, particular organs are allotted, to felect from the whole fome of the parts of which it is compofed: by vegetables, carbonic acid gaz; by the human fpecies oxygene, &c. The action between common air and common matter is reciprocal, and a mixture takes place between both; the compound mixture that is produced bearing a certain relation to the quality of the parts of which it is compofed: on the contrary, the air which the living fyftem has feparated and received, and which muft therefore be called *vital air*,

air, loſes the ſenſible properties it originally poſſeſſed, and becomes ſubſervient to the power of the ſyſtem in which it is contained.

If the effects produced by common air on common matter be further examined, and compared with the effects produced by the animated ſyſtem on vital air, we ſhall find them totally different: the action of atmoſpheric air on animal and vegetable matter, when the aſſimilating and preſervative powers of life have ceaſed, haſtens the proceſſes of putrefaction and decay: on the contrary, every animated ſyſtem demands a perpetual ſupply of it, not only for the production of organic action, but to prevent the decompoſition of them both by putrefaction and decay: in the one it accelerates the ſtate of abſolute death, by weakening and deſtroying the power of preſervation which living matter contains: in the other, it prevents or ſuſpends the ſtate of abſolute death, by ſupporting the action of life.

If we proceed to compare the effects reſpectively produced by ſenſible heat on common and on living matter, we ſhall find the ſame contrariety to ſubſiſt: ſenſible heat poſſeſſes the general property of diffuſing itſelf

equally

equally in all ſurrounding matter of a common kind, until a mean temperature is obtained; and although ſome ſubſtances have a greater capacity than others, either to retain or to part with it, the fact is nevertheleſs generally true, that heat has the property of diffuſing itſelf equally throughout the whole: on the contrary, the animated ſyſtem poſſeſſes the property of preſerving a certain ſtandard within itſelf, and of reſiſting the viciſſitudes which common matter ſuſtains: it is by virtue of this power that it is able to reſiſt the viciſſitudes of climate, without being ſcorched by exceſſive heat, or rendered torpid and frozen when expoſed to extreme degrees of cold; that the different living ſyſtems, inhabitants of the torrid, of the temperate, and frigid zones, are able to preſerve a medium temperature within themſelves, although expoſed to the action of either intenſe heat or cold. The ſtandard heat of the human ſpecies ſeems to be about 98 degrees of Fahrenheit; and in a ſtate of health the animated ſyſtem maintains that internal temperature, although externally expoſed to the ſtrongeſt viciſſitudes of both. The power of reſiſting heat was moſt deciſively illuſtrated by the

the experiments of Mr. Hunter, Sir Charles Blagden, Dr. Fordyce, &c. &c. Thefe gentlemen expofed themfelves in a room heated by means of ftoves to the temperature of 216: others in profecuting thefe experiments fuftained the high degree of 260 externally: but the internal parts of the body on examination preferved the common temperature of 98 or 100. The inhabitants of the frigid zone in general are equally in proof of the power which the animated fyftem poffeffes of refifting the operation of cold: they bear the moft exceffive degrees of it, whilft they preferve their heat; and when the mercury of the thermometer in the open air is often below 0 of Fahrenheit, the blood in the living fyftem maintains the high temperature of 98. This power of refifting heat and cold is not confined to the human fpecies alone; it fubfifts even in a more perfect degree in the brute and in the vegetable tribes. But when the powers of life have ceafed, it obtains the fame temperature, as the matter by which it is furrounded.

CHAP.

CHAP. V.

OF THE OXYGENOUS PHILOSOPHER.

This doctrine the fame as of the Materialift—oxygene, from whence obtained—efpecially from minium and manganefe, and given out as urinous and dead by the vegetable creation, and therefore cannot conftitute the principle of irritability in man—fo believed by feveral eminent men—it is merely the food of living beings, and not the caufe or principle by the power of which they exift.

A SECOND fet of philofophers of a more modern date, have taken great offence at the Materialifts, for fuppofing that fubftances fo grofs and fo indigent could poffefs the power of forming organs endowed with animation and action.

Thefe philofophers virtually and in deed adopt the doctrines of the Materialifts, although they refine, or at leaft vainly think they refine the doctrine, by limiting and confining the matter which they falfely fuppofe poffeffes the power of kneading itfelf into organs, to one fubftance; and which fubftance is called not pure oxygene fimply, but oxygene air.

Oxygene

Oxygene air forms a conftituent part of various fubftances; is produced by various bodies, and obtained by various means *.

It is formed in, and obtained from, the oxyde, or calces of metals and femi-metals, more efpecially of minium or red lead, and the black calx of manganefe: it is alfo perpetually fecreted by the vegetable kingdom in general, as excrementitious and foreign: it is this particular air, this oxygenous matter, which vegetables in the day are conftantly difcharging from the whole external furface of their foliage as urinous and dead, and which thefe pure defecated philofophers dream, conftitutes the principle of Life in which all power effentially refides—the immediate and proximate caufe of irritability in man †!!!

Dr.

* It is formed in the greateft abundance by the immediate union of the matter of light (the folar rays) with atmofpheric matter.

† "From the obfervations," fays Dr. Falconer, "of Dr. Mayow and Prieftley on vital air, and its effects on the blood and refpiration, I was led to confider it as the CAUSE of *irritability*, the PRINCIPAL AGENT in the animal œconomy; and therefore ventured, at an early period, to throw out fome HINTS towards expediting its application to medicine,

Dr. Fothergill of Bath claims the merit of this difcovery in a Differtation which he publifhed on Sufpended Animation; and which obtained him the gold medal, through the phyfiological wifdom of the medical members of the Humane Society. He grounds the merit of his claims on feveral queries which he offered to the public eleven years ago, and to which he now appeals. I fuppofe Dr. Gertanner to be the philofopher who has rankled Dr. Fothergill's mind, and induced him to proclaim the jealoufy he feels for the plagiarifm he has fuffered.

Dr. Gertanner has endeavoured to prove, that all the phænomena of animal Life depend on the prefence of oxygene; becaufe the abfence of oxygene is followed by a ceffation of all animal action. It is very true that the experiments which he performed were limited to the mufcular fibre, which he felected as the fubject of his experiments: thefe experiments

dicine, and more particularly to the theory of animation. The idea at length being adopted by others, has of late been offered as entirely *new!* Be that as it may, &c. &c."

Vide FOTHERGILL's *Differtation on Sufpended Animation.*

7 have

have been prosecuted by different gentlemen both abroad and at home.

That the base of oxygene forms one of the constituent materials both of animals and of vegetables, is readily admitted: by the one it is especially received in the act of inspiration, by the other it is received by absorption; but in no case is it true, that it possesses either life or irritability, whilst it subsists in its pure state, in minium or manganese, and especially in the atmosphere. It constitutes the subject matter only upon which the lungs of the animal act and assimilate, and the medium through which it is conveyed to the blood: and it thus becomes one of the most essential constituents, by which it is preserved in a pure and a healthy state. It is however a constituent part of the blood only, and which becomes separated and changed, perhaps, by the particular power of the brain, constituting the nervous fluid, and filling the canal of which the nerves it would seem are composed.

Neither is it true that oxygene constitutes the *principle* of Life more than the principle of *irritability*. Facts universal prove, that whilst oxygene is given out from vegetables, because

it

it is dead inftead of living; becaufe it is excrementitious inftead of nutritious. That, on the contrary, carbonic acid gas conftitutes the food moft falutary to their evolution: that whilft they fcarcely act upon the one, they vegetate and flourifh when they are able to obtain and feed upon the other.

If we were therefore to admit the hypothefis, that the principle of irritability or of life refided in the air taken in, we ought to conclude that carbone or azote conftituted the principle of vegetable life; that life confequently began out of the body, and ended in it: inftead of beginning in it, and ending out of it.

The mind turns away with naufea from the contemplation of caufes that lead to fuch unfeemly conclufions: it receives with flight, and is difpofed to hold up to derifion, the philofophy of thofe philofophers, who know not how to feparate the effect from the caufe, the fubject matter of a thing from the power by which it is governed, and to which it is wholly fubfervient. The oxygene which the lungs receive is abfolutely dead, with refpect to the fyftem, as much as the food which is in-

troduced into the ſtomach: it is by the energy of theſe organs that theſe different ſubſtances are made to receive the participation of life, and made to anſwer the purpoſes of melioration and ſupport.

CHAP. VI.

OF THE BRUNONIAN SYSTEM.

The doctrine ſtated—it proclaims Life to be a forced, not an original ſtate—an effect of cauſes that are dead—the cauſe ſtated—operating upon the excitability—excitement the effect in conſequence produced, and which conſtitutes Life—the various degrees of it—this doctrine compared with Mr. Hunter's, and proved to have been borrowed from it, or its principal tenets—thoſe parts are true—thoſe parts fabricated by Dr. Brown, falſe—the principle of the doctrine examined and criticized, &c. &c.

ANOTHER doctrine has been lately broached, and very generally adopted. It proclaims *Life* to be a forced, not an original ſtate. This doctrine makes excitement or action the effect of the exciting powers; and the exciting powers both external and internal are ſuppoſed

pofed to be the true and effential caufe of Life *. Thefe exciting powers are ftated to be heat, food, wine, poifons, contagions, the blood, the fecreted fluids, and air: not thefe only; they extend to fuch as proceed from, and are the immediate effect of which mental power is the caufe; as thinking, emotion and paffion, mufcular contractions, and the different functions of the body itfelf.

Thefe are the various agents called by Dr. Brown *exciting powers*, and which are efpecially deftined to act upon, what he calls the excitability of the fyftem †.

* Excitement, the effect of the exciting powers, the true caufe of life, is within certain boundaries proportional to the degree of ftimulus: the degree of ftimulus, when moderate, produces health: in a higher degree it gives occafion to difeafes of exceffive ftimulus: in a lower degree, or exceffively weak, it induces thofe that depend upon a deficiency of ftimulus, or debility: and as excitement is the caufe both of difeafe and of perfect health, fo that which reftores the morbid to the healthy ftate is a diminution of excitement in difeafes of exceffive ftimulus, and an increafe of excitement in difeafes of debility. *Brown's Elements.*

† The property on which the exciting powers act may be named excitability, and the powers themfelves exciting powers: by the word body is meant both the body fimply fo called, and alfo as endowed with an intellectual part, a part appropriated to paffion and emotion, or a foul. *Idem.*

It is further ſtated, that every animated being is allotted a certain portion only of this quality, or principle on which the phænomena of Life depend.

Although it is ſtated as the firſt and moſt fundamental dogma of this doctrine, that a certain portion only of this quality or principle is allotted to every animated being; it is ſuppoſed, that this limited quantity varies in an unlimited manner in different animals: that as this quantity, which was ſtated to be *limited*, is more intenſe, the animal is more vivacious, or more ſuſceptible of the action of the exciting powers: "that excitement, the effect of the exciting powers, conſtitutes the true *cauſe* of Life," p. 14: that this excitement (or this Life) may be too great, too ſmall, or in juſt meaſure, &c.

When too great excitement is induced, weakneſs follows, becauſe the excitability becomes defective: this condition of the ſyſtem is termed a ſtate of *indirect debility:* on the contrary, when the exciting powers, *i. e.* ſtimuli, are withheld, weakneſs is induced alſo; and the term *direct debility* is the name expreſſive of this ſtate: and finally, that if the exciting powers

powers are withdrawn, death enfues as certainly as when the excitability is gone.

The * excitability is fuppofed to be feated in the medullary portion of the nerves and mufcles, to which the appellation of nervous fyftem has been given. In this the excitability is fuppofed to be inherent, but is not different on different parts of its feat: as foon as it is affected any where, the affection is propagated every where: nor is the excitement or action ever increafed in a part, whilft it is diminifhed in the fyftem in general: or, in other words, different parts can never be in different ftates of excitement.

* P. 7. "We know not what excitability is, or in what manner it is affected by the exciting powers: but whatever it is, whether a quality or a fubftance, a certain portion is allotted to every being upon the commencement of its living ftate."

Although Dr. Brown is ignorant of the nature of excitability, he is at no lofs to find where it has its feat in the living body; it is in the medullary nervous matter and mufcular folid, to which the appellation of nervous fyftem may be given. It were to be wifhed that Dr. Brown had found out a feat for the excitability of vegetables alfo; of thofe active and highly vital fyftems that are totally *deftitute* of medullary nervous matter or mufcular folid!

Theſe are the general and fundamental principles on which the whole of the Brunonian ſyſtem is founded, and which are ſtated to be ſo plain, as to be eaſy of comprehenſion by the meaneſt capacity; ſo beneficial to mankind, that the ſcience of medicine is ſimplified, and the cure of diſeaſe rendered more certain than it was before.

So far however from this ſyſtem of medicine being eaſy of comprehenſion, to me it appears involved in the moſt dire confuſion that can be conceived. It makes Life to be an effect inſtead of a cauſe; it makes Life to conſiſt in excitement, and excitement or life to ariſe from ſubſtances that are naturally dead. Inſtead therefore of the principles being founded in truth, they lead to error; ſo far from conſiſtency being apparent in the whole, we ſhall find there is perpetual jarring and contradiction between the text and the context of the different parts.

The parts which appear to me founded in truth were propagated by the late Mr. Hunter, long before Dr. Brown. It is however probable that Dr. Brown wiſhed to conceal the plagiariſm of his knowledge by giving different

ferent names to principles virtually the ſame. Let us therefore compare both ſyſtems together, and we ſhall ſoon diſcover the affinity they bear in points the moſt eſſential. Mr. Hunter ſuppoſed, that every animated ſyſtem poſſeſſed a living principle, and that this living principle was the cauſe of the phænomena of Life. Dr. Brown, inſtead of retaining the term living principle, abandons it, and invents excitability in its ſtead *. Mr. Hunter ſuppoſed that this living principle was ſuſceptible of being acted upon by ſtimuli. Dr. Brown ſuppoſed, that the excitability was acted upon by exciting powers, or the ſtimuli of Mr. Hunter; Mr. Hunter ſuppoſed that theſe ſtimuli, acting on the living principle, produced action. Dr. Brown thinks, that the conſequence of theſe exciting powers acting upon the excitability produced excitement. In this ultimate effect produced; in this excitement, great and

* A Brunonian will probably ſay, that excitability is not life according to the author's meaning: it is, however, very clear, that it is nothing elſe than life: if it be not life, it is what Dr. Brown himſelf ſtates it to be, "that "which we do not underſtand:"—it is in fact nothing— a phantom of the author's imagination, a mere reverie.

 ſtriking

ſtriking indeed was the difference they both entertained. Mr. Hunter ſuppoſed it to be an effect only of life and of organization. Dr. Brown imagined that this excitement itſelf conſtituted life, and was virtually its ſource: the ſource of life indeed at its termination.

It is at this terminated origin, or originated termination, where Life begins, that Dr. Brown ſtops: on the contrary, Mr. Hunter purſues his principles to their ultimate effects. He inveſtigates the power of Life in the converſion of dead into living matter, and the formation of chyle; in the change chyle ſuſtains to its perfect commutation into blood, and to the uſe of blood in the ſupport of the ſyſtem: and he farther aſcertains the various properties it contains, and the particular uſes for which it is deſigned. It appears to me, that when Dr. Brown takes Mr. Hunter as his guide for principles with new names, he is generally right; but when he abandons the road Mr. Hunter* had etched out for him, and

* Although I admit Mr. Hunter's idea of Life in the fulleſt extent, and it is probably in ſome meaſure to him I am indebted (from the ſtock I received whilſt I attended his

and explores one of his own: when we fee Dr. Brown folitary and alone, we then behold principle founded in error, and its application to practice moft dangerous.

The great error of this Brunonian fyftem appears to proceed from this: Inftead of afcribing power to the animated fyftem, in which it evidently refides, and mere aptitude and fitnefs to be acted upon in the matter received, whether it be water and air to vegetables, or the different articles of diet to different animals; he makes the matter which every animated fyftem receives, to poffefs the power, whilft the fyftem itfelf he conceives to be the thing acted upon: he confequently is led to afcribe power to that which is naturally weak, and weaknefs to that which is effentially ftrong: he calls the various fubftances in which the excitability acts (the living principle) *powers*; agents that act, inftead of things that are acted upon:

his lectures) that my mind has been progreffively led to inveftigate the powers and to afcribe the phænomena we behold as its effects; I fhall, notwithftanding, take the liberty to diffent from him in various points. I hope I may be allowed to do this, and yet retain the higheft refpect for his talents and for his memory, which I feel and acknowledge.

upon: he makes life to come out of the body, inftead of refiding within it: inftead of making action the effect of life, he makes life the effect of action*; *for in action (excitement)*, fays he, *the true caufe of life confifts, the effect of the exciting powers acting on the excitability.* Life, therefore, does not confift in the excitability alone, or in the exciting power alone, but in both together†.

It muft however be remarked, that in different parts of his book he exprefsly fays, that the exciting powers conftitute the true

* Article XXIII. Excitement the effect of the exciting power, *the true caufe of Life*, and is within certain boundaries, proportionable to the degree of ftimulus; "fo "*that excitement is the caufe* both of difeafe and of perfect "health."

† Article XXIX. This mutual relation obtains between excitability and excitement, that the more weakly the exciting powers have acted, or the lefs the ftimulus has been, the more abundant the excitability becomes: the more powerful the ftimulus, the excitability becomes the more exhaufted. Again, page 16: Childhood, and *that weaknefs which depends on abundant excitability*, admits of little ftimulus: the fame effect, it is fuppofed, takes place in old age, by a *deficiency of excitability*, and requires a great deal of ftimulus. Here we have one and the fame effect produced by caufes totally oppofite and different; which is contradictory, and therefore impoffible.

caufe

caufe of life. A mutual relation is however fuppofed to fubfift between the excitability and the exciting powers.

When too great excitement (i. e. too much life) is induced, indirect debility follows; becaufe the excitability* becomes defective. On the contrary, when the ftimuli are withheld, direct debility takes place: although the ftate of direct debility is induced by the fubtraction of the exciting powers; it is notwithftanding fuppofed, "*that the excitability is then in ex-*" *cefs*:" fo that when the excitability of the fyftem is moft ftrong, the excitement (or the true caufe of life) ought to be moft weak; and, on the contrary, when the excitement is moft weak, the excitability ought to be moft ftrong*; or, in other words, the excitability is fuppofed to become more abundant in proportion to the weaknefs of the exciting powers; and, on the contrary, in proportion to the ftrength of the exciting powers in producing excitement, the excitability becomes proportionally leffened and diminifhed.

* Page 27, Article XL. During the increafe of excitability the excitement proportionally decreafes; nor is there any cafe in which this procefs, carried far enough, will not produce death.

If

If this fundamental propofition of his doctrine were true, animated beings ought to begin without excitability or animation, and end with a total accumulation of it. Excitability would be moft languid when it is known to be moft active, as in the fœtal and infant ftate, in the evolution of the fyftem, and in the organization of its various parts*: it would be moft active when it is known to be moft languid, and efpecially when it is totally exhaufted, as in the oldeft period of old age; and there ought then to be a total accumulation of this excitability by the infenfibility to the action of ftimuli, and by the weaknefs and ceffation of all excitement.

* But it does not appear that Dr. Brown has provided for fœtal Life: it is removed from the ftimulant effect of thofe general powers which produce excitement, or the true caufe of Life: it is thefe ftimulant powers, we are told, that produce every ftate and degree of health: it is to ftimulus, and to no other caufe: although he afcribes thefe phænomena at one time to ftimulus, at another he refers them to excitability, on which the phænomena of Life depend: a certain portion of this excitability he fuppofes is allotted to every animated fyftem; that it may be exhaufted, augmented, and renewed, as it varies in different fyftems, and in the fame fyftem at different times.

The

The abundant condition of accumulated excitability would be moſt apparent when the ſyſtem is in a paralytic and torpid ſtate, and when there ſeems to be a general apathy of the whole: it ought to be the caſe in ſyncope and ſuſpended animation, whether from ſubmerſion or the effect of cold, when the organs through which the excitability acts in producing excitement are no longer ſuſceptible of the action of ſtimuli*. If this ſpecies of relationſhip actually exiſted between the exciting powers and the excitability, not theſe falſe conſequences only would enſue, but it is alſo very evident, that if Life be the forced ſtate which Dr. Brown has proclaimed, it might be gauged or varied, exhauſted, augmented, or renewed to a high or a low ſtate, and back again from a low to a high one, in proportion as he choſe to infuſe into the ſyſtem brandy or water, heat or cold, oxygene or azote, pleaſure

* Article XLII. During the increaſe of excitability, the excitement proportionably decreaſes, nor is there any caſe in which this proceſs, carried far enough, will not produce death. Again, Article XLIII. This ſuperabundant excitability ſo ſpeedily brings on death, &c. &c. XLIV.

Life is ſolely the effect of ſtimuli. Idem.

or

or pain, joy or grief; that he could make excitability to die, and again to live; and confequently that Life itfelf was what he ftates it to be, a forced ftate; merely produced and preferved by the operation of external powers *.

In all ftates of life, therefore, Dr. Brown fuppofed that man and other animals differ from themfelves in their dead ftate, or from any other inanimate, in this property alone; *they can be affected by external agents as well as by certain functions peculiar to themfelves, in fuch a manner that the phænomena peculiar to the living ftate can be produced.* This propofition extends to every thing vital in nature, and therefore is applicable to vegetables.

This affertion is not a true one: living animals differ from dead in this refpect, they poffefs the power of affecting external fub-

* Article LXXII. It is certain that Life is not a natural, but a forced ftate; that the tendency of animals every moment is to diffolution; that they are kept from it, not by any power in themfelves, but by foreign powers, and even by thofe with difficulty, and only for a time; and then, from the neceffity of their fate, they yield to death.

ftances

ſtances (falſely called agents), and of performing certain functions peculiar to themſelves; and the dead ſtate differs from the living in this, that in the dead ſtate they are affected by external agents, and entirely changed by them; ſo that the very ſubſtances which contributed the moſt to the ſupport of Life when it was in action, accelerate the proceſs of decompoſition, as air, heat, &c. after thoſe actions have ceaſed.

Dr. Beddoes himſelf, aware of theſe conſequences, is obliged to confeſs that his principal tenets, if they be rigidly examined, will be found inconſiſtent with his own important doctrine of the accumulation of excitability. "It appears to me," ſays Dr. Beddoes, "that according to his firſt chapter (xviii) living beings ought to have proceeded through languor to death in an unbroken tenor of wakefulneſs, and that all the images and lamentation which ſleep has ſuggeſted to the poets would have been loſt; for he who aſſigns that a certain portion of excitability is allotted to every living ſyſtem, by that very aſſumption denies its continual production, ſubſequent diffuſion and expenditure, at a rate equal

to

to the ſupply, or greater or leſs. That the brain is an organ deſtined to ſecrete the *matter* of life, he could never have ſuppoſed; otherwiſe he would not have expreſſed a doubt whether excitability be a quality or a ſubſtance." p. 138.

That the matter of Life, as he falſely calls it, is not reſident in the brain alone, was proved by various facts I mentioned, of the *fœtus in utero* being frequently deſtitute of brain altogether, although every other part of its ſyſtem was completely evolved; an evident proof that the powers of life in general are moſt ſtrong, and independent of organization in particular *.

The

* Dr. Beddoes, aware, I ſuppoſe, of this fact, allows "that infants have leſs prediſpoſition than adults to contagious fevers; and that, when they are infected, the chance of recovery is much greater." The reaſon is obvious, and is particularly illuſtrated, if we examine the action of the living principle in different periods of its evolution with the degree of ſuſceptibility to diſeaſe. Although the maternal conſtitution is occaſionally attacked with contagious diſeaſes, as typhus, fever, ſmall-pox, meaſles, lues venerea, &c.—the fœtus, although it occaſionally participates of the confluent, moſt commonly eſcapes it altogether. The reaſon appears evidently to ariſe from the full energy of the excitability in the office of evolution

and

The Life which conftitutes the power of the fyftem in its nature is definite; in point of evolution it is bounded; in point of duration it is circumfcribed; it is gradually developed and evolved; and after having attained its period of perfection, it gradually verges to decay, and becomes decompofed into its conftituent parts: it verges to decay by an exhauftion of the living power, and a confequent inability to act upon extraneous fubftances, by a total lofs of power, either of acting upon external fubftances, or refifting their operation. External things therefore act upon the fyftem, enter into a chemical union with the parts of which it is compofed, and the phænomena of putrefaction or fer-

and of growth; it converts, in the moft eminent degree, the blood it receives into various organs, and deftroys any morbid or fenfible properties it may poffefs, by the perfect and total affimilation it undergoes. It however occafionally does happen, that the affimilating powers of the fœtus are weak, and the morbid caufes are ftrong; and that they do produce the fame effects on the fœtal, as they are wont to do upon the adult frame—caufing the phænomena of difeafe. Hence it is, that infants have occafionally been born with variolous and fyphilitic eruptions, receiving the contamination through the medium of the maternal conftitution.

mentation enſue, as the means which nature employs to bring organized matter into a diſorganized ſtate, and, finally, to reſolve it into a common one.

Thus then it appears that the operation of external things upon the animated ſyſtem, falſely and unphiloſophically called by Dr. Brown *exciting powers*, has a conſtant and unremitting tendency to weaken the organization of the part, to diminiſh or to deſtroy the participation of Life which this organization had received, and, finally, to prevent excitement or action, the ultimate effect of this vital principle acting through the medium of the organs of which the ſyſtem is compoſed.

It was in reverſing this order of things, inſtead of following it, that Dr. Brown fell into confuſion and error; he miſtook excitement for a cauſe inſtead of an effect; he ſaw it an effect produced, and falſely believed it to be a producing cauſe; an effect produced, occaſional and not conſtant, by the organs as the inſtrumental cauſe, from the energy of Life, the primary and eſſential cauſe in which the ſource and power of action eſſentially reſides.

Inſtead of ſuſpending the phænomena which every

every animated ſyſtem diſplays to the excitability, which he at firſt allows, he either divides the cauſe by which theſe phænomena are produced, by aſcribing them to the exciting power acting on the excitability, or elſe he abandons altogether the power of the excitability (of Life), by aſcribing the production of the phænomena to the exciting powers alone, or things external to the ſyſtem: he therefore aſſerts that the operation of this external power produces excitement, and *that excitement itſelf conſtitutes the true cauſe of Life.* P. 14.

It is very evident to me, that Dr. Brown had no definite ideas whatever of the relation which different things bear to each other; that he in conſequence has confounded power with weakneſs, weakneſs with power; frequently miſtaking one for the other, as well cauſe for effect, as effect for cauſe.

The moſt common obſervation ought to have taught him, that although power in the abſtract is a poſitive principle; yet, when it is conſidered as reſiding in any ſubject whatever, it no longer continues a poſitive, but immediately becomes a relative term: the relation of power which the excitability (Life, or living

ſyſtem) bore to the things by which it was ſurrounded, depended on the weakneſs or aptitude they poſſeſs, not of exciting, but of being excited upon; not of changing, but of being changed; not of producing action according to the nature of each, whether bread or meat, brandy or water; but of becoming ſubſervient to the power which the excitability poſſeſſed in which it reſided, and by the energy of which it was diſplayed in the production of action.

The exciting powers therefore, according to him, conſtitute the cauſe, of which excitement is the effect; and in this effect, in this excitement Life is formed, and continues to ſubſiſt; to ſubſiſt indeed no longer than the exciting powers continue to act; to ceaſe the inſtant they are ſubtracted and withheld.

It is therefore neceſſary for me to enquire what are theſe Life-producing powers which poſſeſs this diſtinguiſhed faculty of imparting Life when it is exhauſted; of diminiſhing Life when it is augmented, and of renewing Life when it is diſſipated.

According to him, they are various in number, they are both mental and corporeal. I ſhall

ſhall not extend my enquiry to thoſe that have a direct and immediate tendency to deſtroy Life, inſtead of producing it, and which he has introduced in his Vocabulary, " ſuch as *poiſons*, *contagions*, or thoſe that proceed from the energy of mind, as thinking, emotion and paſſion ; muſcular contraction, and the functions of the body itſelf." I ſhall confine myſelf to the conſideration of thoſe articles which he has eſpecially enumerated and arranged, and which he ſuppoſes poſſeſs in a diſtinguiſhed and graduated degree the power of producing life or excitement. At the head of theſe are, 1. Opium, 2. Spirituous Liquors, 3. Muſk, 4. Cinchona or Bark.

The firſt of theſe Life-producing cauſes is a juice extracted from a well known vegetable called Poppy : it is generally obtained by boiling and par-boiling the heads until an extract is formed : (this extract diſſolved with alcohol makes a tincture): after the extract is obtained, and ſet aſide for months and years, and when it no more reſembles the living vegetable from which it was procured, than it does the human ſyſtem which it is deſtined to reſuſcitate,

or than alcohol does the vegetable by the decompofition of which it is produced.

The fecond is Brandy. It is procured in different countries from different fubftances: in warm climates it is the product of the firft ftage of fermentation which grapes fuftain; it is produced by the death of the vegetable, in confequence of which it becomes decompofed and refolved into a common ftate. In this country, Alcohol is obtained by diftillation from ftinking and damaged wheat or barley.

Thirdly, *Mufk* is an animal fubftance produced by the excretory gland of an animal of the feline clafs; this gland is fituated clofe to the anus of the beaft, and, according to Dr. Brown's opinion, is the third in rank of Life-producing caufes in Man!

The fourth is the Cinchona of Linnæus, or what is vulgarly called Peruvian Bark. This fubftance is the fourth in order, and which is fuppofed to poffefs the power in the fourth degree of producing excitement, or the true caufe of Life. We have a particular and familiar example of the action of bark upon

animal

animal matter, when animal matter has not the power of acting upon bark, or at leaft when there is a mutual action between both: when the bark, the exciting power, acts upon the excitability which the fkin contains, the procefs is called tanning, and the thing produced is called leather : there is an union that takes place between both, between the bark and the fkin. More need not, I believe, be faid upon the fubject to make it more abfurd than it *prima facie* appears.

Thefe are the exciting powers of Dr. Brown, thefe are the effects that they invariably produce, and which evidently prove that Life is not a forced but an original ftate ; that it is not produced or preferved by the *operation* of external caufes *.

* It is foreign to my difpofition to wifh to tarnifh the good reputation of the dead, if it were not with a view of doing good to the living. I fhould therefore leave Dr. Brown's memory with all the character attached to it, if it were not for the mifchief which his doctrines at this moment produce. I know very well, that in this country, the generality of regular practitioners, who claim any pretenfions to fcience, have adopted the Brunonian Syftem altogether, and accommodated their practice to

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it. The influence it has had abroad may be collected from Dr. Beddoes himfelf, in a Note he has inferted at the conclufion of his own Obfervations. "Since the preceding pages were printed," fays the Doctor, "I have received further indubitable proofs of the afcendancy which the truths [he ought to have faid the lies] promulgated by Brown are gaining over men's minds in different parts of Europe. A tranflation of his 'Obfervations' was publifhed at Pavia in 1792, and again re-publifhed at Venice; and in a Letter accompanying a copy of the Tranflation, Dr. Rofari, by whom it is written, fays, 'In the Univerfity of Pavia, undoubtedly one of the firft in Europe, there is hardly a ftudent ENDOWED WITH TALENT, who is not a Brunonian: the doctrine begins equally to fpread in Germany, France, Genoa, and different parts of Italy, &c.'" And again, Dr. B. fays, "The Reader may eftimate what it is to have put fo many nations into the right path of medical inveftigation; and though we fhould be out-ftripped in medicine by the awakened genius of France [in chemiftry, I fuppofe the Doctor means], or the enlightened induftry of Germany, we fhall not be without confolation; fince, in confequence of Brown's difcoveries, our countrymen labouring under diforders, fuch as we cannot cure, ftand a chance of profiting by the collective efforts of human ingenuity!!"

Medical men therefore are not only bound to correct the operation of the poifon which this doctrine is producing throughout Europe; but they are exprefsly called upon by the author himfelf, to attack and controvert it if they can. The author fays, "that in prefixing his name to both forms of his work, he has thrown the gauntlet to its numerous

merous but anonymous oppofers: they are therefore called upon now or never to difprove it, and the judicious and candid part of mankind to judge between the parties." *Vide the Author's Preface*, p. 32.

It has been a matter of aftonifhment to me, whilft books are every day publifhed to enforce the Brunonian doctrine, that none appear to controvert it. I therefore avow to take up the gauntlet; and although I do not mean to follow Dr. Brown through every particular part, I fhall continue to attack in the progrefs of this work his fundamental principles. If I fucceed in proving that they are erroneous, it is impoffible that the application of them to the healing art can be true, or to calculate the mifchief they produce. Nothing indeed will prove in a more decided manner the error of my own opinion, than eftablifhing the truth of Dr. Brown's. I fhall certainly not conceive myfelf bound to anfwer the fuggeftions of his difciples in general, or the bad opinions of bad authors. If however Dr. Beddoes fhould think proper to defend the fyftem he has proclaimed, I promife to give a reply to this very refpectable Gentleman, if I find his matter and manner deferving of one.

CHAP.

CHAP. VII.

OF DR. DARWIN'S DOCTRINE.

Difficult and even impoſſible to underſtand—not ſo with his verſe, always brilliant and harmonious.

IT were improper in me either to approve or condemn a ſyſtem I do not underſtand. I am ready to confeſs that the brilliancy of Dr. Darwin's imagination is too great for the dulneſs of my conception. Truth is not ſo difficult of acceſs; it is error alone wrapt up in compound and affected language that cannot be attained.

When Darwin ſings, by fairy fancy bleſt,
Of love-ſick roſes, and of ſhrubs diſtreſt;
Charm'd with thoſe ſtrains that elegantly flow,
Like him we languiſh, and like them we glow:
But, Science, when he ſeeks thy thorny way,
And hopes to rival Truth's immortal day;
Then rural Loves the vain attempt deplore,
And ſylvan Nature knows her bard no more.

CHAP.

CHAP. VIII.

THE PROCESSION OF LIVING BEINGS.

A general review of the whole chain of animated exiſtence—vegetables proved to be more perfect in their frame than brutes—brutes more perfect than the human ſpecies—the reaſon ſhewn to ariſe from the difference in the final cauſe of their exiſtence—the aſſertion teſtified by facts taken from the different orders of living beings—their preſervative and procreative powers ſtated—the different periods of longevity in vegetables in general, and animals in particular, &c. &c. &c.

IF we take a general review of the ſyſtem of nature, we ſhall be led to conclude, that a regular chain of order and ſubordination exiſts not only in the common matter of which it is compoſed, but alſo of the various animated beings it contains. The analogy that ſubſiſts between the different links of this vaſt chain is ſo gradual and eaſy, that it is often very difficult to ſay where the one ends and the other begins; what are the different marks by which ſome part of the mineral kingdom is

is diſtinguiſhed from the vegetable, and ſome ſpecies of the vegetable from the animal, until its final termination in the human ſpecies.

Although the relation and ſimilitude which the various individuals bear to the ſpecies, as well as the different ſpecies to the ſame genus, are great and ſtriking, there notwithſtanding ſubſiſt ſhades of difference between every part; ſo that, when the extremes are compared, inſtead of analogy there is a total difference between them. Vaſt and immenſe as the chaſm actually is, which ſeparates both, it notwithſtanding is filled up by a regular proceſſion of beings both animal and vegetable, until we finally terminate at formleſs and inanimate matter, all poſſeſſing different powers, faculties and aptitudes, concatenating the two extremes; the perfect with the imperfect, the rational with the irrational, the active with the paſſive, the ſimple with the compound, the organized with the diſorganized, that God may be all in all in connecting every thing together.

In taking a general review of this kind, we ought to contemplate the nature of the various orders of animated beings, when placed in ſituations congenial to the nature of each, and

and not when they have been removed to different climates, and exiſting in different media for which they were never deſigned: it is then that we ſhall find that the living power of vegetables is ſtronger than that of brutes, as the living power of brutes is ſtronger than that of the human ſpecies; and that we ſhall behold the ſelf-ſufficiency of the one and the total indigency of the other.

It is univerſally true, that the perfection of every ſyſtem depends on the power it poſſeſſes of being ſufficient to itſelf, without the addition of any external aid: on the contrary, the imperfection of every ſyſtem conſiſts in the number of its wants, and in the degree in which it is deſtitute of the means by which thoſe wants can be ſupplied, without the poſſeſſion of which it could not fulfil the final cauſe of its exiſtence.

Aſſuming ſelf-ſufficiency as the ſtandard of perfection in every ſyſtem, with a view of accompliſhing the final cauſe of its exiſtence; let us now make a curſory examination of the different powers the vegetable and animal ſyſtems poſſeſs, not only with reſpect to their ſeveral

veral wants, but to the means by which thoſe wants can be relieved.

Vegetables are fixed to the earth by their roots, as the proper element for them to reſide, and are placed by nature in ſituations where they find nouriſhment without ſeeking for it. The coral, that is ſituated at the bottom of the ſea, on which it feeds, is ſelf-ſufficient without organs of loco-motion, or of apprehenſion. On the contrary, the moſt complicated animals are loco-motive in the medium of air; in their infant ſtate they are totally indigent of themſelves; without the protecting hand of their parents, or of foreign aid, they no ſooner come into exiſtence than they would be immediately cut off; and in their adult ſtate they cannot obtain means of ſupport without labour and fatigue. The former vegetates and flouriſhes for months, years, and even centuries, by means of fluids only,—of the ſimple nouriſhment of water and of air, which they principally receive through the medium of the ſoil. The latter require not fluids only, but ſolids alſo, either of an animal or vegetable kind, for their nouriſhment and ſupport;

ſupport; they are perpetually indigent of air; their vital actions immediately ceaſe, if they are deprived of its influence, either by immerſion, inhumation, or ſtrangulation.

Vegetables have their organs of vitality and of incretion, ſecured from foreign danger, and in a certain degree from the influence of climate, by their reſidence in the earth. The human ſpecies, by its reſidence in the air, is perpetually expoſed to the viciſſitudes of climate, and is often born in deſtitute ſituations; it often falls a prey to the voracity of the brute, and to the barbarity of man. The moſt ſimple and ſelf-ſufficient vegetables receive nouriſhment from every part by the moſt ſimple poſſible means. On the contrary, the human ſpecies cannot exiſt without food, and without air taken in by particular parts; and it is not without an elaborate proceſs that they contribute to the immediate ſupport of their ſyſtem, or are employed for the purpoſe of ſecretion in general, or procreation in particular. Such is the ſelf-ſufficiency of the moſt perfect vegetables, that they flouriſh and propagate without the neceſſity of having organs of ſenſe or of apprehenſion. On the contrary, ſuch

ſuch is the abject and imperfect condition of the human ſpecies in this reſpect, that without organs of apprehenſion it could not poſſibly obtain the means of ſupport; it would periſh for want, without fulfilling the end of its exiſtence.

If we caſt an eye on the ſurface of the earth, we ſhall be at once convinced of the prolific power of vegetables, and of the lower order of animals, with relation to thoſe of a higher claſs. Whilſt ſome vegetables can be propagated by branches and buds, by ſeeds, by ſuckers, and by leaves; the higher order of animals have not only their mode of propagation limited to one, but they require the union of two ſubjects before it can be accompliſhed.

If we compare the propagating power of each, we ſhall be at once convinced of the prolific nature of the one, and of the comparative ſterility of the other. One ſingle plant of elecampane ſhall frequently produce, in one ſeaſon, above three thouſand ſeeds, the poppy three thouſand two hundred, the ſunflower four thouſand, and the tobacco plant would ſeem to have no bounds to the extent

of its propagating power; it has been known to bring to maturity forty thoufand three hundred and twenty feeds. If it were not, therefore, for the deftruction which vegetables fuftain by the various animals to which they afford nourifhment, not only the bofom but the furface of the earth would be a vaft animated column.

The prolific power of the infect tribe is equally notorious: a fingle mite will, in a few days, reproduce its fpecies a thoufand times *.

Endlefs would be the tafk to enumerate the immenfe quantity of ova which fifh evolve: the roe, or ovarium, when arrived to maturity, is frequently as large as the fifh in its torpid condition. The fize of the ovarium is particularly ftriking in the amphibia, as the frog, turtle, &c. There was a turtle killed in London two years ago, out of which two thoufand five hundred eggs were obtained; and it is probable that in tropical climates there are many that are far more prolific.

* So attached was Lewenhoek to the propagating power of the infect tribe, that he ufed to keep lice in his ftockings, in order to behold their wonderful powers of propagation!

Although the propagating power of birds is more limited than of fiſh, it certainly is very conſiderable. Hens frequently lay forty or fifty eggs in one ſeaſon; and when we reflect that pigeons can hatch nine times in one year, they can multiply their ſpecies in four years near fifteen thouſand times *.

The power of procreation certainly ſuffers conſiderable abatement in the higher order of animals, and more eſpecially amongſt thoſe that are particularly diſtinguiſhed for the magnitude of their ſize, and the degree of rationality they poſſeſs. An elephant ſeldom produces more than one young in two years; whilſt, on the contrary, rabbits and cats propagate every ſix weeks.

In vegetables, the act of evolution is effected independent of the parent ſtock. They ſhed their ſeed, fiſh depoſit their ſpawn, and oviparous animals lay their eggs; and ſuch is the perfection of this living power they poſſeſs, that the influence of the medium in which they are depoſited is generally adequate to anſwer the purpoſe of vegetation and of incubation. We all ſee the multitude of maggots that are ge-

* Vide Encycl. Brit.

nerated in rotten cheefe, and of other infects that are produced in other animal matter that is undergoing the procefs of putrefaction. On the contrary, in the higher order of animals, the evolution of the offspring is totally indigent of its parent during the period of geftation, and which marks the diftinction between viviparous and oviparous animals: in the latter conception is the caufe, of which geftation is the neceffary effect, and parturition the ultimate refult.

If we examine the various orders of animals, we fhall find that the difficulty of parturition and the concomitant danger progreffively increafe from the moft fimple to the moft complicated; that it is lefs in vegetables than in animals; lefs in oviparous than in viviparous; lefs in brutes than in the human fpecies; and, finally, lefs in favage than in polifhed nations. The labour and anguifh of the parent till that awful and important procefs is accomplifhed, the lamentation and cries of the infant as foon as it is born, all prove the imperfection and indigence of the human frame *.

If

* No doubt can exift but that the vegetable fyftem very

often

If the offspring produced be examined, we ſhall find that the ſimilitude it bears to the parent is more perfect in vegetables, and in the lower order of animals, than it is in the higher, and eſpecially in the human ſpecies; and that monſtroſities and deformities are leſs frequently ſeen in the one than in the other. The deformities we occaſionally behold in vegetables can generally be traced to ſome mechanical cauſe in the ſoil: on the contrary, in the human ſpecies, it is impoſſible to aſſign any reaſonable cauſe for the various præternatural appearances we frequently behold individuals poſſeſs; and if I were diſpoſed to admit that maternal deſires or propenſities could have any influence on the offspring, it would only be a ſtronger proof of the imperfection of the ſpecies; it would ſhew, that when the imagination is moſt ſtrong the power of corporeal perfection is moſt weak; weaker, therefore,

often ſuffers in a very conſiderable manner, in conſequence of its prolific nature. Trees frequently die from exceſs in their generating power, and we often find that their prolific powers are weakened when they have borne too much fruit the preceding year. An exception alſo ſeems to exiſt amongſt cats, as they very often fall victims to the effects of parturition.

in

in the moſt enlightened than in the moſt imbecil of mankind; and, finally, weaker in the brute than in the vegetable tribe.

If we compare the powers of reſtoration which vegetables poſſeſs, and eſpecially thoſe of the moſt ſimple kind, with thoſe of the moſt complicated animals, and eſpecially of the human ſpecies; the ſuperiority of the one is as remarkable as the inferiority of the other. Vegetables poſſeſs the power of cicatrizing wounds, and of reſtoring limbs that have been deſtroyed*. The human ſpecies are wholly deſtitute of the power of reſtoring limbs; they only retain the capacity of cicatrization, either by granulation or ſimple adheſion of the ſides. Although it is true that there are ſome diſeaſes to which vegetables are expoſed, theſe are principally confined to thoſe ſyſtems whoſe natural powers have been weakened by the art and ſkill of the botaniſt. I admit that in many inſtances they have been meliorated with a view to our uſe, but their

* In the claſs of Fungi, the more their different parts are cut, the quicker they grow: ſo great indeed is the extent of their living power, that one would almoſt ſuppoſe it to be inexhauſtible.

 own

own health and ftrength have been impaired by cultivation and difcipline. On the contrary, the human fpecies, from the complication of its fabric, has various wants with which it muft be perpetually fupplied, and is predifpofed to various difeafes from which the vegetable fyftem is totally exempt.

Vegetables fuffer læfion and violence to an almoft infinite extent, without having their prefervative or even vegetating power deftroyed. It is the cafe with the firft and lower order of animals and of brutes. The power of the polypus, and of reptiles, in this refpect, is particularly ftriking. Worms, eels, and various others of the fame clafs, may be cut into the fmalleft pieces, and each piece fhall ftill retain the power of motion; and the amphibia, as the turtle, frog, &c. live for a confiderable time (feveral months) after decapitation, or lofs of the heart: and the fact mentioned by Spallanzani, and witneffed by many others, may be here ftated—that the male toad, that was beheaded during the act of fexual intercourfe, was not incapacitated, or even deterred from accomplifhing the object of its amour.

While

While infects and hair-worms have been completely dried, by expofure to the fun, and afterwards parched up in an oven; at the expiration of fix months, water was poured upon them, and their action progreffively returned.

If we afcend, and examine the power of animals whofe external organization is apparently the fame as that of the human fpecies, we fhall find that thofe far exceed that of the other. I fhall merely mention the optic power of the lynx, and of the whole feline fpecies, that diftinguifh objects when they are to us involved in obfcurity and darknefs: the auditory and olfactory faculties of different fpecies of the canine race, with their power of motion.

Shall I fpeak of the ftrength and magnitude of the elephant and whale? Although it would feem that the largeft whales have been moftly deftroyed within the arctic circle, inftances occafionally happen in the torrid zone, by which we can judge of what they ufed to be, and where they are ftill near 160 feet in length.

Shall I fpeak of the felf-fufficiency of the camel or the dromedary, that fupports itfelf

for months, without other drink than what is ſupplied from the internal reſervoir of water it contains? If we trace the reſpective power, and examine the organization of different ſyſtems, we ſhall be led to conclude, from a ſurvey of facts, that vegetables in general, and the moſt ſimple animals in particular, have their wants moſt limited, and are placed by nature in ſituations where thoſe wants can be moſt readily ſupplied; on the contrary, that the more complicated animals, and eſpecially the human ſpecies, are infinitely more helpleſs and more indigent than any of the reſt; requiring the aſſiſtance of more external cauſes, with leſs inherent power in the animal itſelf by which it can ſupport itſelf.

If we examine the various means by which the ceſſation of vital action may be induced, either immediately or through the medium of diſeaſe, we ſhall find that there is an endleſs variety in the morbid ſtate of the conſtitution; and that the *noſology* of *aſphyxia (i. e.* ſudden death) comprehends various genera and ſpecies.

The premature mortality of the human ſpecies in *utero*, and in the infant ſtate, when compared

pared to animals or vegetables, may be ftated as a further proof of the imperfection of its frame: not lefs than one half are reported to die before they have paffed the fhort period of their early infancy.

How often it is prematurely fhortened we have daily opportunities to witnefs. How far it may be extended, is with tolerable accuracy limited, and known. Thofe who preferve their power, and enjoy their faculties, for fixty or feventy years, may be confidered as fortunate beings: thofe who reach to fourfcore are expofed to decrepitude and difeafe: and though this would feem to be the deftined period of human exiftence, there are various exceptions which occafionally occur, when we find it greatly extends thefe boundaries: the Philofophical Tranfactions record various inhabitants of thefe kingdoms that have attained very advanced periods of longevity; I fhall mention a few of the moft remarkable of thefe, viz.

Henry Jenkins was born in Yorkfhire, died December the 8th, 1670, aged 169; he was twelve years of age when the battle of Flowdenfield was fought, in 1513: it feems from records in the Court of Chancery, that

he

he had an oath adminiftered to him, and appeared as an evidence 140 years before his death: he was a fifherman by occupation, and was able at the age of 100 to fwim acrofs rapid rivers.

James Bowles, of Killingworth, died Aug. 15, 1656, aged 152. He was a menial fervant to a poor farmer: at 120 years of age he fell in love, and had the courage to marry a widow for his fecond wife; and it is ftated with apparent fidelity, that fhe repeatedly declared, during the twelve years they were united, that fo far from betraying any figns of infirmity, he was of a warm amorous nature: it may be further ftated, that thefe old people were brought up in penury, and lived on the coarfeft food; and finally fubfifted by the precarious affiftance from alms.

Thomas Parr, an inhabitant of Shropfhire, died Nov. 16, 1635, aged 152.

Amongft the females it is ftated, in an article in the London Chronicle, that a negro woman, called Louifa Trufco, born in Inconia in South America, aged 175, was ftill living Oct. 5, 1780: and it is mentioned in Raleigh's Hiftory, that the Countefs of Defmond, a native of Ireland, was 140 years old.

Thefe

Thefe inftances of longevity are fhort-lived when compared to the exiftence of the antediluvians, including a period of 1600 years; the inhabitants were giants in fize, and almoft eternal in their exiftence. Adam has by fome been fuppofed to have been 900 yards in height, and in age near 1000 years. Shall I fpeak of the 900 years of Methufalem?

The amazing longevity of the inhabitants before the Flood, when compared to thofe born after it, has caufed feveral attempts to be made, with a view of reconciling the difference. The difference in the chronology of thofe days has been fuppofed to create the miftake: it has been thought by fome, that the antediluvian year was equivalent to our lunar month only.

Others again have thought that the year until the time of Abraham confifted only of three months, and afterwards extended to eight; and that it was not until the time of Jofeph that it was made to confift of twelve *.

Although it appears from fcripture, in

* It is worthy of remark, that it is ftill the practice amongft fome eaftern nations to reckon three months only to the year.

the

the latter end of the 5th chapter of Genefis, that the Patriarchs at firft lived to the period of 1000 years; it is remarkable that in the beginning of the 6th, we are told, that for the wickednefs of man his days were fhortened, "when the wickednefs of man was great on the earth, and that every imagination of the thoughts of his heart was only evil continually."

If the firft conjecture be true, then muft it follow, that the antediluvians, inftead of being longer were fhorter lived than the poft-diluvians; and if the fecond conjecture be true, the 1600 years before the Flood will be reduced to 414; and the 900 years of old Methufalem will be reduced to 200. Be this as it may, we know that, at the time David wrote, "the days of our age were threefcore years and ten; and though men be fo ftrong that they come to fourfcore, yet is their ftrength then but labour and forrow, fo foon paffeth it away, and we are gone."

On the contrary, if we examine the age of different animated fyftems, we fhall find that it far exceeds that of the human fpecies. In their tame and domefticated ftate, oppreffed with

labour and ſlavery, elephants have been known to live 130 years: in their natural ſtate, they often exceed 200, and propagate their ſpecies till they are 120: it is thirty years before they have attained their fullneſs of growth.

Amongſt birds, the eagle, the falcon, the vulture, may be ſtated as inſtances of longevity alſo: many eagles have been preſerved in menageries above one hundred years; and a falcon was caught at the Cape of Good Hope, with a golden collar, on which was inſcribed "*His Majeſty K. James of England, Anno Dom.* 1610." It had been at liberty 182 years from the time of its eſcape; and it is uncertain how long it had ſubſiſted in a ſtate of captivity. It ſtill poſſeſſed ſome ſtrength and activity, but its plumage was become white, and its eyes were blind.

It is very difficult to ſpeak with preciſion, with reſpect to the extent of the life of fiſh; but when we know that a common carp, confined in a common fiſh-pond, ſhall frequently exceed 100 years of age, we may conjecture the indefinite period of exiſtence allotted to different fiſh that inhabit the ocean. A friend of mine has ſeveral oyſter ſhells, natives of the Indian

dian ocean, and called Keemo, whofe immenfe dimenfions are worthy of being recorded. The largeft is in length 3 feet 4 inches, in breadth 2 feet 3 inches, in thicknefs 14 inches, and in weight, without the upper fhell, 220 pounds.

The age of vegetables may be afcertained with more facility and with more accuracy. The different layers of which the wood is compofed are diftributed in circles nearly concentric to each other, one of which is formed every year; fo that if we can afcertain the number of layers of which the wood of a tree is compofed, the extent of its age may be underftood: thefe circles are particularly evident in the oak. Linnæus diffected one, in which he counted 300 of thefe layers, from whence he concluded it was as many years of age.

There is an oak growing in Penfhurft Park, in Kent, well known by the name of the Bar Oak, not lefs remarkable for the extent of its dimenfions, than for having been planted on the day that the celebrated Sir Philip Sydney was born: within the hollow of it there is a feat capable of containing five or fix perfons with eafe:

The

		Feet.	Inch.
The girth close to the ground	——	35	6
Ditto 1 foot from ditto	——	27	6
Ditto 5 feet from ditto	——	27	0
Height taken by shadow	——	73	0
Girth of the lowest but not largest limb		6	9

At Tortworth, in Gloucestershire, there is a chesnut tree 52 feet in circumference: so far back as the year 1150, it was remarkable for its size, and distinguished in name by the great chesnut of Tortworth; so that now it is probably 1000 years old. I shall conclude this part of the subject, by relating Messrs. Howell and Brydone's account of the great chesnut tree growing upon Mount Ætna, and which has been for so many years the admiration and astonishment of every traveller and botanist. It is, according to Mr. Howell's account, 160 feet in circumference, and quite hollow within; within this hollow, there is an oven for the purpose of drying nuts, almonds, and chesnuts, with a view to conserving. I find, however, that this account does not immediately correspond with Mr. Brydone's. This famous tree, known by the name of Castagna da cento Cavalli (from the circumstance that 100 horses and their riders had sheltered themselves

ſelves under it during a ſtorm, when Jane of Arragon viſited Mount Ætna), ſays, that it is only a buſh of five large trees growing together, that were once apparently united; the circumference of which, Mr. Brydone and Mr. Glover found amounted to 204 feet: another riſing on a ſingle ſolid ſtem, cloſe to the former one juſt mentioned, meaſured two feet above the ground 76 feet in circumference.

A Table of the Duration of Life in certain Animals.

INSECT TRIBE.	Years.
The Spider - - -	1
Scorpion - -	1
Cricket - - -	10
FISH.	
Crayfiſh - -	20
Pike - -	100
Crocodile - - -	100
Tortoiſe -	100
Carp - - -	150
BIRDS.	
Hen - - -	10
Peacock - - -	24
Nightingale, from	16 to 18

The

		Years.
The Canary bird, if it breeds	-	10
——————— if it does couple	-	24
Lark, from	- -	16 to 18
Sparrow-hawk	- -	40
Goofe	- - -	50
Swan	- - -	100
Eagle	- - -	100
Parrot	- - -	110
QUADRUPEDS.		
Squirrel	- - -	7
Hare, from	- -	7 to 8
Rabbit, from	- -	8 to 9
Goat	- - -	10
Sheep	- - -	10
Fox	- - -	15
Cat	- - -	18
Ox, employed in agriculture	-	19
Cow	- - -	20
Hog	- - -	20
Wolf	- - -	20
Bear	- - -	20
Dog, from	- -	20 to 28
Deer	- - -	20
Horfe, from	- -	25 to 30
Bull	- - -	30
Afs, from	- -	25 to 50
Camel, from	- -	50 to 60
Lion	- - -	60
Elephant, from	- -	150 to 200*

* This very curious paper is taken from the Monthly Magazine, and is a tranflation from the German.

M A N.

Suppofing the earth peopled with 100,000,000 inhabitants, and allowing 33 years for a generation, it has been computed, that the deaths of each year amounted to	30,000,000
Of each day, to - - -	82,135
Of each hour, to - -	3,442$\frac{7}{24}$
But as the number of deaths is to the number of births, as 10 to 12, there are born, every year, - - -	36,000,000
Every day - - -	98,569
Every hour - - -	4,107$\frac{1}{24}$

If mankind had not been doomed to die, there would have been, at prefent, about 173,000 billions of mortals on the earth ; and in this cafe, there would ftill have been 9110 fquare feet of earth remaining for each man.

Reckoning only three generations during a century, and fuppofing, at the fame time, that the world has only exifted 5700 years, there have been only 171 generations from the creation to our own time, 124 fince the deluge, and 35 fince the Chriftian æra. Now, as no family in Europe can trace its origin to the time of Charlemagne, it follows, that the moft ancient houfes cannot reckon more than 30 generations, and very few, if any, can go fo far back. But fuppofing it to be the cafe, what is this, but

but 1000 years illuftration, againft 4,800 years of obfcurity?

On an equal fpace, where there exifts,

In Iceland	1 Man	Germany	127 Men
There is in Norway	3	England	152
Sweden	14	France	153
Turkey	36	Italy	172
Poland	52	Naples	192
Spain	63	Venice	196
Ireland	99	Holland	224
Switzerland	114	and	
Great Britain	119	In Malta	1,103

Out of every 1000 men, 28 die off annually.

The number of inhabitants of a city or country, is renewed nearly every thirty years.

Of 200 children, no more than one dies in the birth.

Of 100, one does not die during the mother's lying-in.

Of 1000 infants, fed by means of the mother's milk, not above 300 die; but of the fame number reared by wet-nurfes, 500 die. The mortality of children has augmented greatly during the prefent luxurious age; convulfions and teething kill the greater number of them.

The natural fmall-pox ufually carries off eight in every hundred attacked by it; but of 300 inoculated, no more than one dies.

Among 3125 who die, it appears, by the regifters, that there is only one perfon of 100 years of age.

More old men are to be found on elevated fituations, than on plains and valleys.

The proportion between the deaths of women, and that of men, is as 100 to 108. The probable duration of female lives is 60; but after that period, the calculation is more favourable to them, than to the males.

Married women live longer than maidens.

In the country, the fpring is the moft fatal period; but in great cities, it is the winter.

One-half of thofe who are born, die before they attain the age of 17: thus, they who furvive that period, enjoy a degree of happinefs, which a moiety of the human race is unable to attain.

The number of old men, who die in cold weather, is to the number of thofe who die in warm weather, as 7 to 4.

According to the obfervation of Boerhaave, the moft healthy children are born in the months of January, February, and March.

The married women are to the unmarried, in the ratio of 1 to 3; and the married to the unmarried men, as 3 to 5. The number of

twins

twins born is to that of ſingle children, as 1 to 65 or 70.

The number of marriages is to that of the inhabitants of a country, as 175 to 1000.

In the country, there are about four children produced by every marriage; in cities, there are but 35 to 10 marriages.

The men able to bear arms, form the fourth part of the inhabitants of a country.

Number of inhabitants in all the great cities and towns of the world:

Amſterdam	220,000	Bourdeaux	150,000
Aſtracan	70,000	Briſtol	60,000
Avignon	10,000	Brunſwic	28,000
Bagdad	500,000	Bruſſells	80,000
Barcelona	63,000	Buda	21,000
Bâle, Baſle or Baſil	15,000	Cadiz	30,000
Baſtia (in Corſica)	5,000	Cairo	200,000
Bremen	40,000	Calcutta	600,000
Breſlaw	60,000	Charlſton	11,000
Breſt	24,000	Coblentz	12,000
Batavia	144,000	Conſtantinople	1,000,000
Bergen	16,000	Copenhagen	90,000
Berlin	151,000	Cork	87,000
Berne	10,000	Dantzig	48,000
Birmingham	60,000	Dreſden	50,000
Bologna	70,000	Dublin	150,000
Bonne	11,000	Edinburgh	85,000
Boſton	25,000	Embden	7,500

Florence	84,000	Marfeilles	30,000
Franckfort	43,000	Mentz	27,000
Ghent	60,000	Mexico	160,000
Genoa	110,000	Milan	132,000
Geneva	27,000	Modena	30,000
Glafgow	30,000	Mofcow	500,000.
Gottingen	7,600	Nantes	80,000
Gotha	11,000	Naples	440,000
Gottenburg	20,000	Newcaftle	40,000
Hamburgh	120,000	Nice	12,000
Hanover	16,400	Norwich	40,000
Haerlem	20,000	Oftend	16,000
The Hague	37,000	Padua	38,000
Laufanne	8,000	Palermo	120,000
Leyden	48,000	Paris	600,000
Leipfic	32,000	Pekin	2,000,000
Liverpool	60,000	Peterfburgh	220,000
Liege	82,000	Philadelphia	35,000
Limeric	32,000	Pifa	20,000
Lifbon	200,000	Potfdam	28,000
Leghorn	45,000	Ratifbon	22,000
London	800,000	Rome	165,000
Loretto	4,000	Rotterdam	50,000
Lubec	30,000	Seville	120,000
Lucerne	6,394	Stockholm	80,000
Lucca	3,000	Shalmud	13,000
Lyons	150,000	Strafbourg	47,000
Madras	300,000	Stutgard	23,000
Madrid	154,000	Thorn	10,000
Manchefter	65,000	Tiboli	18,000
Manheim	22,000	Tobolfk	15,000
Mantua	28,000	Toledo	20,000

Triefte

Triefte	18,000	Weflar	4,600
Turin	80,000	Wittenberg	7,000
Venice	150,000	Wurzeburg	20,000
Verona	57,000	York	12,700
Verfailles	40,000	Yverdon	2,200
Vienna	270,000	Zanguebar	15,000
Ulm	15,000	Zittau	10,000
Utrecht	32,000	Zuric	12,000
Warfaw	120,000		

Admitting then the truth of thefe facts, which we are taught by obfervation and experience, the queftion preffes itfelf upon the mind, with force irrefiftible, How comes it to pafs, that the vegetable fyftem, whofe living power is more extenfive and more durable than that of the brute, fhould hold the laft rank in the great chain of animated exiftence? And on the contrary, that the human fpecies, which is more complicated, and confequently more imperfect in its corporeal frame than either brutes in general, or the vegetable kingdom in particular, fhould have dominion over the whole, and ftand the firft in the whole race of generated beings? The reafon of this difference appears to me evidently to proceed from the difference in the final caufe, which each fyftem was refpectively defigned to fulfil.

CHAP. IX.

FINAL CAUSE OF VEGETABLE EXISTENCE.

The diſtinction between aggregation and chemical attraction—aſſimilation from chemical attraction—ſecretion from aſſimilation—theſe proceſſes common to both vegetables and animals—conſequently not the cauſe by which they are diſcriminated—Mr. Hunter's opinion erroneous in this reſpect—the true diſtinction appears to ſubſiſt in a nervous ſyſtem, of which vegetables in general are deſtitute—the final cauſe of vegetable exiſtence proved.

THE great and ſtriking marks I have already mentioned, by which common matter is diſtinguiſhed from living, makes it unneceſſary for me to expatiate any farther upon the ſubject. I ſhall merely ſtate, that when two maſſes of common matter are added together, an increaſe of bulk is produced; and if both maſſes are the ſame in kind, there is no further difference in the quality of the whole: and finally, when different maſſes of matter, of different ſpecies, are brought together, and an union takes place between them, the compound formed always bears ſome relation to the quality of the parts out of which it was produced,

produced, whether it be an acid or an alkali, a metallic ore or an aëriform fluid. On the contrary, the act of aſſimilation or of digeſtion differs from chemical attraction, and from the attraction of aggregation, in this reſpect: the act of digeſtion aſſimilates DIFFERENT kinds of matter to ONE, which is made ultimately to aſſume the form of the ſyſtem to which it is applied. It is in this *unifying* power, I ſay, which the aſſimilating organs poſſeſs over diſcordant and heterogeneous materials, that the act of digeſtion differs from the phænomena of chemical union and combination, or from the ſimple addition which a maſs of common matter receives—homogeneous in its kind.

This aſſimilating power pervades throughout the whole range of animated exiſtence; it is the ſame in kind in animals as it is in vegetables, although there is a difference in the ſtructure of the organs by which this effect is produced. In both ſyſtems the aſſimilating organs are elaborated by the energy of the living principle: in both they are ſubſervient to the ſame uſe, and in both are regulated by the ſame laws.

Finally, digeſtion differs from *ſecretion* in this

this refpect: digeftion converts different kinds of matter to *one* kind: on the contrary, the act of *fecretion* converts *one* fpecies of matter to *different* kinds, as we behold in the various fecreted fluids that are produced by the fecretory organs from the blood of the fame animal, or the medulla of the fame plant.

It is not therefore in the act of digeftion in general, or of fecretion in particular, that vegetables are diftinguifhed and characterifed from animals: thefe proceffes, common to both, are more perfect and extenfively diffufed in the moft fimple and irrational fyftems, than in the moft complicated and intelligent; in the vegetable than in the brute; in the brute than in the human fpecies.

It was owing to an improper apprehenfion of things, that the late Mr. Hunter was led falfely to afcribe the difference by which an animal was to be characterized from a vegetable, to the exiftence of a ftomach. Mr. Hunter ufed to define an animal to be an organized fyftem having a ftomach, in contradiftinction to a vegetable, which he fuppofed to be deftitute of one.

That this definition is an erroneous one, will evidently appear, if we examine what a

ſtomach actually is, and the uſe to which it is ſubſervient. A ſtomach is an organ which receives matter of different kinds, and by the power of which, theſe various kinds of matter are converted or aſſimilated into one; by vegetables into medulla, by animals into chyle. Would Mr. Hunter have ſaid, or will his advocates in this reſpect pretend to ſay, that vegetables are deſtitute of this power? When we behold the wonderful vegetable ſyſtems that are evolved from the moſt ſimple ſpecies of nouriſhment, we may conclude that their appetite is moſt voracious, and their digeſtive power moſt perfect: the converſion and change that take place in the water and air which vegetables receive, and out of which their ſyſtem is produced and perfected, are far greater, and require more energy in the organs, than in the animal matter on which carnivorous and omnivorous animals prey and feed.

There is ſome analogy between the matter of beef and mutton, upon which we habitually feed, and of the animal matter of which we are compoſed; but there is a total difference between the food of vegetables

(water

(water and air) and the vegetable matter to which they are ultimately converted; whether the vegetable matter of a cabbage or of an oak, the efflorefcence of a rofe or a fun-flower, the fructification of a peach or of a pine-apple.

There are feveral fyftems exprefsly allowed by Mr. Hunter to be of an animal kind, and which are deftitute of what Mr. Hunter would have called a ftomach. I fhall merely inftance a few of thefe. The tænia, inftead of having a bag for a ftomach, has numerous veffels pervading every part of its body, and which perform the fame office: the hydatid, and feveral other of the lower order of animals that were fuppofed to have ftomachs, are now found to be compofed of procreating organs. If we examine the higher order in their *fœtal ftate*, we fhall find that they fometimes exift without a ftomach; and that they conftantly fubfift in that ftate without its action. If the exiftence of a ftomach were to be taken as the diftinguifhing teft between an animal and a vegetable, it would follow, that the *fœtus* was not an animal, but a vegetable; and if we were to refer the affimilating power of different fyftems, as the ftandard of their excellence, we

we ought to conclude that vegetables are far more excellent than animals.

We may in ſome degree conceive the nature of vegetable exiſtence, by contemplating the action of our involuntary organs either of digeſtion, or of chylefaction, of abſorption, or of circulation, abſtracted from the action of our organs of ſenſe, and of voluntary motion.

The action of digeſtion is an involuntary act, performed in the moſt perfect and eminent degree, not only without the effort of the will; but an effort of the will has a tendency to impede and even to ſuppreſs it.

As we aſcend in the general chain of animated exiſtence, we are able to diſtinguiſh a great and an evident difference in the organization: it is very probable, that in a few ſpecies of vegetables; of thoſe that border on the animal tribe, ſomething like a nervous arrangement may exiſt, performing the office of a nervous ſyſtem. When the bloſſom of the ſunflower follows the beams of the ſun from eaſt to weſt, the dionæa muſcipula, by the contraction of its leaves, ſeizes flies and makes them priſoners. The ſenſitive plant becomes

tremulous

tremulous and irritable throughout the whole of its frame, when any of its parts are forcibly impreſſed. When various plants have their corolla expanded and opened, contracted and cloſed at particular periods, and when acted upon by particular ſtates and temperatures of the atmoſphere, we ought, I think, to allow that theſe effects cannot be the offſpring of the living principle alone; on the contrary, that it ariſes from ſome ſmall degrees of ſenſitive power, which conſequently muſt reſide in a nerve, as the ſyſtem alone which is appropriated to poſſeſs this power—as much, indeed, as the faculty which we behold in the oyſter on opening its ſhell at the afflux of the tide.

Limited and ſmall however muſt theſe voluntary powers be, when we reflect on the fixed and immovable ſpot to which theſe vegetable ſyſtems are chained, and the ſhort life the efflorescence is ſuffered to enjoy; it is no ſooner arrived at its ſtate of adoleſcence than its perfection is attained, and its period of caducity enſues.

This nervous power, if it be one, does not extend to the ſyſtem in general, but appears to be

be principally confined to the efflorefcence, in which the fexual organs are fuppofed to refide; it is when the vegetable fyftem is unfolded, when its ftate of perfection is attained, and when it is about to fulfil the final caufe of its exiftence in the production of fructification.

When we behold the regularity with which the action of vegetables is performed, we are naturally led to conclude, that thofe actions, conftant and invariable as they feem to be, flow from caufes operating uniformly and immutably the fame, without any oppofing or controlling power in the fyftem itfelf, by the energy of which thofe actions could either be fuppreffed or prevented: there is therefore an appointed period of growth for the different organs of each, and an appointed feafon when the difpofition to act begins and ends; THE FINAL CAUSE OF WHICH SEEMS EVIDENTLY TO BE THE PROPAGATION OF THE SPECIES—as means of affording nourifhment and fupport to beings of a higher clafs.

CHAP.

CHAP. X.

FINAL CAUSE OF BRUTAL EXISTENCE.

Animals eſpecially diſtinguiſhed from vegetables by the nervous power they poſſeſs—the proximate cauſe of taſte, what—the organs of ſenſe of different orders of animals examined, with relation to their brain—more extenſive and powerful than in man—on the contrary, the brain of man large, and its organs of ſenſe ſmall—the final cauſe of brutal exiſtence, what.

IF we proceed from the vegetable to the animal creation, and examine the comparative anatomy of different claſſes of each, we are able evidently to diſtinguiſh a progreſſive increaſe in the complication of the organization, with a diminution of digeſtive power. The digeſtive organs of animals, inſtead of being diſperſed and extended like thoſe of vegetables, throughout the whole external ſurface of their frame, have a particular part to which this office is eſpecially allotted: the former immediately act upon the ſubſtances by which they are ſurrounded, and convert them into nouriſhment and ſupport; on the contrary, the latter, how

 ſimple

ſimple ſoever their organization may otherwiſe be, have not their food immediately applied to their digeſtive organs; they firſt receive it through the medium of their organs of maſtication, with which they are ſupplied: we find theſe organs ſubſervient to the energy of a nervous ſyſtem, connected with a ganglion, with a brain, or with a ſpinal marrow, ſubſiſting in the ſame ſubject, either ſeparately or all together.

It is in this nervous power, that the proximate cauſe of taſte reſides. The cauſe of taſte does not reſide in the food received, but in the organ by which it is ſelected: it is by the energy of theſe nerves, and which are principally confined in the moſt ſimple animals to the ſenſe of taſte, that we behold them diſplay fondneſs and averſion, action and remiſſion, appetite and inanition: in a common leech we all know its fondneſs for blood, and its averſion to ſalt.

It is by the energy of this nervous ſyſtem which animals poſſeſs, that the organs of maſtication are made to act, and directed to their proper end. Maſtication produces comminution of food, without its converſion: on the contrary, digeſtion produces not only com-

minution but converſion alſo: it is only when the act of maſtication ends that the act of digeſtion or of converſion begins.

I ſhall therefore proceed from theſe inferior orders of animals, and aſcend to thoſe of an higher claſs, and endeavour to aſcertain the cauſe why the appetite in the brute is ſtronger than that of the human, whilſt the rational power is weak; and on the contrary, why the rational power of the human ſpecies is ſtrong, and, in its improved ſtate, its appetite is comparatively weak; or, in other words, why the former are inſtinctive and not rational animals, and, on the contrary, why the latter is a rational and not an inſtinctive being.

The ſmallneſs of the whole inſect ſyſtem renders it a matter of difficulty to deſcribe with any preciſion any one organ in particular of which it is compoſed. Such, however, is the comparative magnitude of the organs of ſenſe with which they are ſupplied, that they can be eaſily detected: for example, the caterpillar has ſix eyes on each of its ſides. In the bee, the eyes are not only of a very large ſize, but the area of their ſurface is greatly extended by the nature of their conſtruction. In ſhape they are like a diamond, having 100 dif-

ferent ſurfaces, by means of which they are enabled to take in at once a very large number of objects.

In the ſnail, the eyes are diſtinctly placed at the extremity of its horns; there are beſides a number of nervous fibrils that ariſe from the mouth, and, after congregating together, form a circular nerve, as its brain. Vain however would be the attempt of giving a particular deſcription of the mode of their fabrication.

*Of the optic Organs * of Fiſh.*

THE optic organs of fiſh far ſurpaſs in magnitude thoſe of terreſtrial animals; the dimenſions of the humours are not only greater, but their quantity alſo. Dr. Monro found that the eye of a cod is very near the ſame weight and depth, and its axis of the ſame depth, as the eye of an ox; he compared the

* I think it proper to ſtate, that I have principally collected the facts with reſpect to the organs of ſenſe of different animals, from profeſſor Monro's valuable book on the anatomy of fiſh; from profeſſor Harwood's firſt Faſciculus on the olfactory organs of different animals; and I am happy to acknowledge my obligation to Mr. Cooper, the preſent ingenious teacher of Surgery at St. Thomas's Hoſpital, for ſeveral valuable facts relating to comparative anatomy in general.

 ſpecific

ſpecific gravity of the aqueous and the cryſtalline and vitreous humours of both, by weighing them both ſeverally, in air and in water; he found their relative weight to be as follows:

	Parts
Spring water - - -	1000
The aqueous humour - - -	1000
The vitreous humour of the ox - -	1016
The vitreous humour of the cod - -	1013
The whole cryſtalline lens of the ox -	1104
The whole cryſtalline lens of the cod -	1168
The outer part of the cryſtalline lens of the ox	1070
The outer part of the cryſtalline lens of the cod	1140
The nucleus of the cryſtalline lens of the ox	1160
The nucleus of the cryſtalline lens of the cod	1200

On comparing the cryſtalline lens of the ox with that of the cod, he found the radii of the ſpheres which compoſe the lens in theſe two animals to be in fortieths of an inch, nearly as in the following table:

	Parts
The radius of the anterior part of the lens of the ox	21
The radius of the anterior part of the lens of the cod	14
The radius of the poſterior part of the lens of the ox	15
The radius of the poſterior part of the lens of the cod, and which is nearly an hemiſphere -	$13\frac{1}{2}$

And, in the laſt place, he found that the focus of the rays of the ſun, which was nearly

1-40th

1-40th part of an inch in diameter, was diſtant from their poſterior part,

In the ox $\frac{13}{40}$ths of an inch.
In the cod not more than $\frac{3}{40}$ths.

And he obſerved that the diſtance of the focus from the ſurface of the whole lens, or from that of the nucleus in the cod, was nearly the ſame.

The focus of the nucleus of the lens of the cod, and which is nearly ſpherical, placed in water, was about $\frac{16}{40}$ths of an inch diſtant from its back part: hence, ſays he, it is evident, that the cryſtalline lens of the cod, but eſpecially its nucleus, is much more denſe, and refracts light more readily than that of the ox.

Upon the whole, therefore, he concludes, that the primary uſe of the almoſt completely ſpherical figure of the cryſtalline lens of fiſhes, or great convexity eſpecially of the anterior part of the lens, which in a cod projects about $\frac{7}{40}$ths of an inch beyond the iris, is to take in a large field of objects around them; which was particularly neceſſary, as the motion of their neck is inconſiderable; and that the vitreous humour of the eye, which is much lighter

than that of land animals, admits to the rays of light a more immediate paſſage to the retina, on which the image is impreſſed and brought to a focus.

The retina may be conſidered as the baſe or origin of the optic nerve: the optic nerve of the right eye goes to the left ſide of the brain, where it terminates: and, on the contrary, the optic nerve of the left eye goes to the right portion of the brain; they decuſſate over each other without uniting; there is a ſubſtance placed at the bottom of the eye, called *tipitum*, which is thought to act like a mirror, and reflects the rays of light, drawing them to a focus, ſo that fiſh in general can ſee perfectly well in the night-time; and the *tunica conjunctiva* is ſeparated from the *cornea*. Fiſh have no eye-lids; that they may be on the watch, and avoid the animals to which they ſerve as a prey.

Of the Eye of Birds.

The eye of birds is protected in a very particular manner, by a ſtrong membrane which ariſes from the inner angle of the eye, called *membrana nictitans*, and which the animal

mal can extend and cover over the whole ſurface of that organ *. In owls, whoſe optic nerves are very acute, this membrane generally covers the eye in the day-time; the ſclerotic coat, which is very firm and thick, appears as it were flattened over its anterior ſurface: there is a black purſe, which extends from the cryſtalline lens as far as the optic nerve, which is moved by the action of a muſcle, apparently deſigned to flatten the lens as the retina may demand.

* The wonderful optic powers of predacious birds was ſtrongly witneſſed in the year 1778, by Mr. Barber, and ſeveral other gentlemen, who were upon a hunting party in the iſland of Caſſimbuſar, in Bengal, about fifteen miles north of the city of Marſhedabad. They killed a wild hog of an uncommon ſize, and left it upon the ground near their tent. About an hour after it was killed, they were walking near the ſpot where it lay: the ſky was perfectly clear, not a cloud to be ſeen, and a dark ſpot in the air, at a great diſtance, attracted their notice; it appeared gradually to increaſe in ſize, and moved directly towards them: as it advanced it proved to be a vulture, flying in a direct line to the dead animal, on which it alighted, and began to feed voraciouſly. In leſs than an hour ſeventy other vultures came in all directions, ſome horizontally, but moſt of them from the upper regions of the air, in which, a few minutes before, nothing could be ſeen.

Of the Eye of Quadrupeds.

The large axis of the eye in ſome quadrupeds is perpendicular, in others it is placed in a tranſverſe direction: the graminivorous kind have it generally tranſverſe, as the ox, horſe, &c.: on the contrary, the feline or cat kind have it perpendicular.

When a tranſverſe ſection of the eye is made, and the humours allowed to eſcape, the tipitum is found ſituated in the poſterior part of the choroid coat. It would ſeem to be owing to the reflection which the rays of light ſuſtain by this ſubſtance, that the eyes of cats in the dark appear luminous like a flame; and, from the magnitude of the pupil, which allows a great multitude of rays to enter, that horſes and other animals are able to ſee ſo perfectly in the dark, and find their way better than man *.

* I recollect one very dark night to have been ſurpriſed at a ſudden leap which my horſe made, and from no reaſon apparent to me. Wiſhing to know the cauſe why, I diſmounted; and on ſhuffling with my feet (it was too obſcure for me to diſtinguiſh any object) I found a man lying acroſs the road in an intoxicated ſtate, and which my horſe was ſolicitous to avoid.

Of

Of the Olfactory Organs in Fishes.

The nofe of fifh is generally placed more backward than that of other animals. The folid part of this organ is compofed of cartilaginous fepta, or tendinous ligaments, varioufly difpofed, on the furface of which the olfactory membrane is fpread: it is of a dark colour, and refembles the choroid coat of the eye.

This membrane is difpofed into two feries of parallel laminæ, each of them inferted (like the teeth of a double comb) into a middle or cartilaginous feptum, by which they are fixed, and the two feries connected together.

The laminæ are half an inch in length, and one inch in breadth, and confequently expofe a very confiderable furface to the water, which paffes in a current through every interval in its way through the throat and gills.

The furface is not extended by this ftructure alone; the olfactory membrane is folded into feveral doublings connected together in the centre, from which the plicæ proceed like radii towards the circumference.

It is from this widely expanded furface, on which the olfactory nerve is fpread, from whence I conceive it has its origin: the mi-

nimæ

nimæ fibrillæ gradually unite into larger fibres, and ultimately congregate into two branches, and which terminate in the anterior lobe of the brain.

Of the Olfactory Organs of the Amphibia, as the Turtle.

THE nose of the turtle, as that of most animals, is divided by means of a septum into two cavities, which are lined on all sides by a cartilage: from the septum and other cartilages there arise several processes, on which the olfactory membrane is spread, from the surface of which the olfactory nerves have their origin: they are of great magnitude, and after running in parallel directions for the space of an inch in a deep groove, which forms the upper and fore-part of the head, they finally terminate in the anterior lobes of a very small brain.

Of the Olfactory Organs in Birds.

BIRDS, whether carnivorous, granivorous, or omnivorous, have their olfactory bones of a turbinated character*: their fabric is of a

* Ossa turbinata was the term which the ancients used when they described the olfactory bones of the herbivorous animals.

cartilaginous

cartilaginous rather than of a bony nature, and their different convolutions approach to a ſpiral form, as in the buzzard and turkey: on the contrary, in the caſſowary, albatroſs, eagle, pelican, hornbill, &c. they are rather membranous than cartilaginous. They are compoſed of bony fibres, curiouſly reticulated, and of conſiderable extent, and communicate immediately with the noſtrils. The olfactory membrane is ſpread on theſe different parts, and which ſeems the proper recipient for the expanded origin of the olfactory nerves.

The true olfactory nerves are ſmaller in the granivorous than they are in the carnivorous kind: in the firſt, their diſtribution is limited to the membrane which compoſes or ſurrounds the turbinated ſtructure, and lines the inſide of the noſtril. On the contrary, in the carnivorous birds eſpecially, nature ſeems to have made an extraordinary proviſion of cells for the diſtribution of the olfactory nerves. The large protuberance on the head of the caſſowary, which Buffon calls *le caſque conique*, is evidently intended by nature for the greater expanſion of the nerves.

It

It is impoſſible to diſcover the origin of theſe nerves in general, although ſome of their branches may be diſtinctly ſeen: they are of a looſe and pulpy texture; and often uniting, they paſs through ſeparate holes into the brain, and not through the perforation of a ſieve-like proceſs *.

Of the Olfactory Organs in the Carnivorous Quadrupeds.

In the carnivorous quadrupeds, as the ſeal,

* Profeſſor Harwood, in his very valuable book, ſeems diſpoſed to think that another pair of nerves (which from its magnitude and office has been miſtaken by the older anatomiſts for the firſt pair, and which, in the granivorous birds, is analogous to the naſal branch of the fifth pair in the human ſubject) is in the carnivorous tribe of much higher importance, being not only a ſubordinate, but neceſſary auxiliary to the olfactory ſenſe. The profeſſor is rather diſpoſed to believe that they belong in part to the true olfactory nerve; if not, they ſolely become an auxiliary organ to it. In the duck, they are ſpread over the mandibles, both within and without, and covered over by a tough, thin, and almoſt tranſparent membrane, as ſoft and as ſmooth as poliſhed leather: they penetrate the orbit of the eye through ſeparate foramina, and terminate in the medulla oblongata.

the

the dog, the fox, and the cat, inftead of turbinated bones, there is, and efpecially in the firft of thefe animals, a bone of a very intricate ftructure, which occupies nearly the whole of each noftril, refembling the fection of the brain, and which has obtained the name of arbor vitæ.

The principal trunk is attached to the rifing arch of the maxillary bone, and directs its courfe downwards towards the os palati. Eight or more principal branches arife from this trunk; each of them is afterwards divided and fubdivided, until the eye is weary of following them; and more than 100 minute ramifications were counted on one of the eight, and that one not the moft confiderable in fize: thefe ramifications are not merely offeous fpiculæ, but the minute edges of bony plates of exquifite tenuity, about one inch in length, and one-twentieth of an inch in breadth. The olfactory membrane is diftributed over the whole of this widely extended furface, which is fuppofed to cover in each noftril an area of 120 fquare inches!!! Although thefe ramifications are larger in the feal than in the fox or dog, and larger in thefe than in the

the feline ſpecies, great and aſtoniſhing muſt be the olfactory ſenſe in all.

Animals, however, of this kind principally depend on their olfactory ſenſe; the organ is of ſuch a length in dogs, cats, pigs, &c. that they are under the neceſſity of lapping their drink, inſtead of drinking it in one draught: if they drank inſtead of lapping it, reſpiration would ceaſe, and ſuffocation enſue; becauſe theſe animals breathe for the moſt part through their noſtrils. In the hog, the *ſenſe of feeling* is principally ſituated at the extremity of the noſe, owing to a very large nerve that paſſes through the upper orbitary foramen, and which is diſtributed at the extremity of the noſe: it is by the noſe that they grope for food, and the olfactory ſenſe on which they principally rely.

Of the Olfactory Organs in the Herbivorous Quadrupeds.

THE olfactory bones of the herbivorous quadrupeds, ſuch as the horſe, ſheep, goat and deer, have an apparent ſimilarity in their ſtructures, and a turbinated form ſeems to have ſerved as a model for the whole.

The turbinated bones are of conſiderable length

length and breadth, reaching from one extremity of their noſtrils to the other; they are of a ſpiral form, and pierced on all ſides by numerous perforations: theſe perforations are more abundant in the deer than in the goat, in the goat than in the ſheep, in the ſheep than in the horſe. In addition to the turbinated bones, the ethmoidal proceſſes afford a conſiderable ſurface for the extenſion of the olfactory membrane. Not only the olfactory bones are of conſiderable magnitude, but the frontal and maxillary ſinuſes alſo: the former, it is probable, conſtitute the immediate olfactory organs, the latter perform an auxiliary office only.

Of the Human Noſe.

The human noſe is divided into two diſtinct cavities, by the medium of the *ſeptum naſi*, within which the *conchæ ſuperiores et inferiores* are ſituated: they extend as far back as the arch of the palate, communicating with the different parts that are concerned in the various faculties of taſting, ſwallowing, and breathing.

All the external parts of the noſe are covered

vered with a ſoft thick membrane, plentifully ſupplied with blood-veſſels. Upon that part alone which lines the external nares, properly ſo called, and *probably on that part only*, Dr. Harwood thinks that the ramifications of the olfactory nerves are diſtributed. He rejects, and with apparent probability, the notion that the ſinuſes are conducive to the olfactory ſenſe; not only becauſe the branches of the olfactory nerves have been traced by different anatomiſts, as Hunter, Monro, &c. as far as the external nares, and no farther; but becauſe, although the air ſhould have free acceſs to theſe ſinuſes by the poſterior openings, little or no perception of ſcents is diſcovered if the external apertures of the noſe be obſtructed. He rather ſuppoſes them inſtrumental to the vocal organs, to increaſe ſound, improve the tone, and aſſiſt in modulating the voice; and finally to ſeparate a mucous fluid to lubricate the nares, on which the expanded extremity of the olfactory nerves is ſpread, as a protecting medium by which they are defended from the acrimony of volatile bodies.

On the whole, therefore, it appears very clear, that the olfactory ſenſe is leſs acute in

man

man than in any one animal of the ſame claſs: his noſtrils are relatively ſmall, and the conchiform bones are not calculated to extend the ſenſitive ſurface in any great degree.

CHAP. XI.

THE SENTIENT PRINCIPLE IS NOT THE SAME AS THE LIVING.

The ſentient principle different from the living—the cauſe why—does not exiſt in vegetables—is more extenſively diffuſed in the lower than in the higher order of animals with reſpect to the ſize of the brain—the cauſe of inſtinct *ſhewn to proceed from this relation between the power of the organ of ſenſe and weakneſs of brain—the final cauſe of brutal exiſtence aſcertained.*

THAT the ſentient principle is not one and the ſame as the living, will be apparent if we examine the nature of the different beings on which the energy of each is particularly exerted. If the ſentient principle were the efficient and immediate cauſe of Life and of health,

health, difeafe and death would be the infeparable attributes of vegetables in general, and of animals in their fœtal ftate in particular. It is far otherwife.

Vegetables and the loweft order of animals poffefs a more abundant fhare of living power in proportion as they are deftitute of any fentient faculty. It is owing to the fimplicity of the vegetable fyftem, that the different parts of which it is compofed continue in a ftate of perfection, without fuffering the fame mutation and decay that we behold animals, and efpecially the moft complicated, fuftain. The whole may be divided into parts, and each part ftill retains the power of vegetation and of reftoration. The mere divifion or feparation of the branch from the trunk, or the trunk from the root itfelf, feldom produces immediate death in any of thefe parts: the vegetative power is checked, but not deftroyed; it continues to fubfift, fo long as the cortical part of the plant has power to convert into its own nature the fluid medium by which it is furrounded. On the contrary, the organs of fenfe with which animals are endowed, are the inftruments which the fentient principle employs, by which they obtain

obtain nouriſhment and ſupport. If it were poſſible to deſtroy the nerves of ſenſe even in the inferior order of animals, the living principle would be unable to ſubſiſt; the whole ſyſtem would periſh through want, without fulfilling the end of its exiſtence.

Although in animals, and eſpecially the lower order, the organs of ſenſe and the nerves which they encloſe are in general of great abſolute magnitude, and in moſt inſtances of greater comparative magnitude than we behold them in man; yet, we find that the ſize of the brain in thoſe animals is relatively ſmall, and bears no proportion to the ſize of the nerves of ſenſe.

The brain of inſects, with relation to the ſize of the organs of ſenſe, and the magnitude of the body together, is much ſmaller than that of fiſh; the brain of fiſh ſmaller than of birds; the brain of birds ſmaller than of quadrupeds; the brain of monkeys ſmaller than that of the human ſpecies.

It is owing to the comparative magnitude of the organs of ſenſe with relation to the brain, that the power of the brain is weak, whilſt that of the organ of ſenſe is ſtrong: the appe-

tite therefore of the organs, and the gratification they receive from external objects, cannot be counteracted or controlled by the debile and imperfect power of the brain, or the seat in which consciousness resides.

Without the intervention of these organs of sense, it is impossible that animals could obtain any knowledge of external objects; without the eye, of colour; without the ear, of sound; without the olfactory sense, of flavour; without the tongue, of sapid bodies; and without the sentient nerves, of sensation. It is by the essential and inherent power which those nerves possess, that animals are able to distinguish in an intuitive manner the situation in which they are destined to reside, and the substances best fitted for the support of their frames. This knowledge may be truly called INSTINCTIVE: it is more perfect in the lower than in the higher order of animals, more perfect in the brute than in the human species: it is owing to the perfection of this instinctive knowledge, that the duck in ovo pecks its shell and waddles into the water; that the infant, as soon as it is born, expresses by the motion of its tongue and lips the want which

which the organ feels, and that it felects milk and rejects vinegar.

This fentient power feems to be inherent in the fentient nerves which the organs of fenfe contain ; and the energy of that power is immediately exerted without inftruction or previous experience. Inftinct is the power in the organ of fenfe; it is the appetite of the organ of fenfe, and the dormant condition of the rational organs. The moft irrational fyftems therefore are the moft inftinctive; they perform their action in a regular and in a definite manner: the energy of the brain always co-operates with the impreffion it receives from the organs of fenfe; and the voluntary powers which arife from the brain, and are fubfervient to its energy, obey its will: THE FINAL CAUSE OF WHICH SEEMS TO BE THE GRATIFICATION OF THE APPETITE, AND THE PROPAGATION OF THE SPECIES.

CHAP. XII.

THE FINAL CAUSE OF HUMAN EXISTENCE.

*The intelligent principle ſhewn to be different from the ſentient or living—is reſident in the higher more perfectly than in the lower order of animals—their brain is comparatively large, their organs of ſenſe ſmall—*Mind *or* Soul *defined—its powers over the organ of ſenſe during its action—its independence of them during abſtraction—has a conſtant tendency to weaken the powers of life—is the cauſe of the ſpecific action in the brain like that of other glands, but excited by other means—the relation of the ſize of the brain in particular to the ſyſtem in general, of different animals—the human ſpecies leſs inſtinctive but more rational than brutes—the final cauſe of its exiſtence proved.*

THAT the ſentient principle is not the ſame as the living, was apparent when we reviewed the difference that ſubſiſted between vegetables and animals in general.

If we reflect on the ſuperiority of power in the ſentient organs of brutes, with reſpect to thoſe of man, and the object on which their energy is particularly exerted; and, on the contrary,

contrary, examine the rational power of man, with relation to the imbecility of the brute, we ſhall be led to conclude that the rational power is different from the ſentient.

The rational power, ſtrictly ſo called, and known by the various appellations of SOUL and MIND, conſtitutes the paramount preſiding principle, of which the brain is the immediate recipient: it is the eſſential and inherent power of Mind, which conſtitutes the efficient cauſe * by which the ſpecific actions of the brain are produced: the brain itſelf is evolved and organized, perfected and preſerved by the energy of the living principle; it receives impreſſion from without by the energy of the ſenſitive; but it is by the power of MIND that the actions of the brain are diſplayed either in the production of vo-

* An efficient cauſe may be defined, that power that produces ſomething ſubordinate to itſelf: as, for example, life is the efficient cauſe of body, becauſe life is ſomething ſuperior to body—that is, as an incorporeal principle.

An inſtrumental cauſe is nothing more than a medium by which an efficient cauſe acts: thus organization is the inſtrument through which the principle of life diſplays its powers; the brain, the inſtrument of thought and volition; the nerves, of ſenſation, &c.

luntary motion in conſequence of impreſſions received, or in the more particular acts of abſtraction or contemplation. Without Mind, the impreſſion produced on the ſenſes by external objects would be illuſory and of no effect: it is by the ſenſes that we feel, but it is by the power of the brain that we are conſcious of feeling. If the communication between the brain and organ of ſenſe is deſtroyed, although impreſſions are conveyed to the organ of ſenſe, we are not conſcious of thoſe impreſſions: on the contrary, the mind has the eſpecial power of recalling to recollection objects that are paſt, equally with thoſe that are preſent: the impreſſions which the organs of ſenſe receive are tranſient, and become weakened from the moment of their reception; on the contrary, the reflecting power of mind frequently makes weak impreſſions ſtrong, and ſtrong impreſſions weak.

That the brain is not the ſource of ſenſation, is further probable from hence, that compreſſion and other injuries of the brain, inſtead of increaſing, diminiſh ſenſation to the total abolition of it: on the contrary, ſenſation is increaſed in proportion to the ſtrength of the

compreſſing cauſe which is applied to the organ of the nerves of ſenſe. We ought not however to view the organ of ſenſe abſtracted from the brain: it is by the one that impreſſions are received; but it is in the other where they are depoſited: without organs of ſenſe we could have no ſenſation; but without brain, we could have no conſciouſneſs of ſenſation excited.

That the brain is the organ in which conſciouſneſs reſides, and is different from the organ of ſenſe, is alſo evident from this; that when the Mind is intenſely employed in abſtraction and contemplation, the impreſſions produced upon the organs of ſenſe excite no ſenſible effect on the Mind: it is able to accommodate and reconcile itſelf to different ſituations and impreſſions. It was this conſciouſneſs and power of Cato's mind that made it indifferent to objects of ſenſe, and deſpiſe the effects they were capable of producing: he knew, that the ſoul, ſecure within itſelf, could ſmile at the drawn dagger and defy its point. It is with a view to this power of Mind alſo, that Patience is repreſented ſitting on a monument ſmiling at grief. Although Mind

Mind in its perfect and active ſtate, has the power of abſtracting itſelf from the ſenſations which the organs of ſenſe produce; it muſt however be obſerved, that this energy of Mind has a conſtant and unremitting tendency to weaken and exhauſt the power of the body; and, on the contrary, the Mind itſelf becomes conſtantly impeded by the alteration and change which the body ſuſtains.

The energy of both cannot exiſt, *in the plenitude of their power*, at one and the ſame time, more than life and death, health and diſeaſe, pleaſure and pain, contemplation and fatuity, ſleep and watchfulneſs, motion and reſt, the action of evolution in general, and the ſpecific action of organic power in particular; or, finally, more than the exiſtence of two ſeparate diſeaſes together in the ſame place, and at one and the ſame time: when either the one or the other accedes, the other departs; the body, or the organ, remains: the body is the ſubject matter, the inſtrument only, the offspring of the living principle.

Admitting then the actual exiſtence of three ſeparate principles in animals in general, and in

in the human ſpecies in particular, it muſt evidently appear, that there are particular organs deſtined for the ſeparate energy of each; and that all the actions which flow from theſe organs, muſt depend on the nature of the principle to which they are ſubſervient, and by which they are governed: it muſt follow, that the vital organs, or thoſe parts ſubſervient to the energy of the living principle, have one mode of action, diſtinct from the brain and nerves, as the organs ſubſervient to the energy of the rational and ſenſitive. A proper arrangement in the organization becomes neceſſary for the reception of theſe ſpecific powers: until the living principle has evolved the organs, theſe ſpecific powers are in capacity only, and in a dormant ſtate, &c.

It is not until theſe organs are perfectly developed, that they become properly fitted to act, and when their dormant powers can be diſplayed in energy and action. It is by the energy of the living principle that the organs are formed and preſerved; but it is by virtue of the ſpecific power they contain, that the difference in their actions is produced. The mere matter

ter itſelf which compoſes theſe organs, is as imbecile and inert as the ſhoe without the foot, as the muſical inſtrument without the art and power of the muſician. When the power of the muſician is united to and exerted upon the inſtrument, we behold as it were an animated ſyſtem; a principle that acts, and an organized inſtrument that is acted upon. When the voluntary powers of the muſician are ſuſpended, the inſtrument itſelf becomes totally paſſive and inert; or, when it is defective and in want of repair, it is impoſſible that harmony can be produced, however eminent the ſcience or perfect the power of the muſician may be; becauſe the inſtrumental medium, through which that harmony is deſtined to be conveyed, is unapt to receive the impreſſions, and therefore unfit to convey the harmony that the art and power of the muſician impart to the inſtrument.

This is preciſely the relation which the principle of life bears to the matter it has animalized and organized, and which the ſpecific powers, which the different organs poſſeſs, bear to the organs themſelves, by means of which their actions are produced.

When the organs are either defective or difeafed, they are unable to perform the action which the fpecific power they contain imparts to them—as the liver to convert blood into bile, the teftes to convert blood into femen, or the brain itfelf, as the recipient of fenfation and inftrument of thought, to perform the action which the mind imparts. It is the effential power of the mind which becomes the primary caufe of the fpecific action which we are confcious the brain difplays, and which becomes the inftrumental caufe of confcioufnefs and of thought. Without this fpecific action of the brain, the mind would be in a dormant ftate, like the fpecific power of the fœtal teftes. The aptitude which the brain or any other organ poffeffes to receive impreffions, and communicate thefe fpecific powers, conftitutes its health, and is the means by which their fpecific action is produced, and the dormant power of the mind roufed and called forth into energy and action. This fpecific power of a gland may continue, although the energy of that power is not exerted in the production of action. In like manner mind, or the fpecific

cific power of the brain, has ftill a fubfiftence, although the action of the brain is fufpended. The rational and living principles therefore, as caufes, may be contemplated in the abftract, as feparated and diftinct from the effects they produce. The living principle conftitutes the caufe, by the energy of which the various parts are congregated into one whole, and that there is harmony and confent between all the parts. And finally, it is owing to the energy of the rational principle, that the different voluntary parts are made to act and are directed to their proper end. When we contemplate the infinite and almighty effence of the Deity, comprehending within itfelf, unity of power and of effence the moft higheft and moft profound, in which there is an infinite and eternal power of acting; we muft conclude, that in the infinite multitude of parts which common matter contains, it muft be wholly deftitute of any power of acting, but retain total paffivity alone.

It is well obferved, and elegantly expreffed by profeffor Harwood, " that when we diffect the brain, and obferve the different fubftances

ſtances of which it is compoſed, and their different forms, imagination, aſſuming the office of reaſon, would willingly aſſign a peculiar uſe to every part; and pronounce one to be the reſidence or rather the inſtrument of memory, another of abſtraction, a third of volition. When a ſenſation is excited by the action of any ſubſtance upon the body, we immediately perceive upon what part of the body the ſubſtance acts, where the impreſſion begins; and as the impreſſion is conveyed by the nerves to the brain, it is conceivable that we might have been ſo conſtituted, as to perceive with the ſame facility in what part of the brain the impreſſion ends. This, however, experience teaches us, we are not able to determine. The ſkill of the anatomiſt has demonſtrated every proceſs, explored every cavity, and would, if poſſible, have traced every filament of this inexplicable maſs of that wonderful and anomalous organ, placed on the doubtful confines of the material and ſpiritual worlds! Nor have the phyſiologiſt and metaphyſician been leſs eager to diſcover, or to aſſign to each part its peculiar office. Whatever may be due to the former

for

for accuracy, and to the latter for ingenuity and zeal, we muſt lament that little knowledge has reſulted from their labour. At this advanced period of ſcience, when almoſt every other ſubject has been illuminated by the experiments, the deductions, and even by the conjectures of the learned, we are not able to proceed a ſingle ſtep beyond the fathers of medicine, who in the very infancy of our art pronounced this inſcrutable maſs of organized matter to be the fountain and the reſervoir, and the beginning and the end of the whole nervous ſyſtem, where every idea originates, and to which every ſenſation is referred."

It were an object of importance to aſcertain the relative magnitude of the brain, with reſpect to the organs of ſenſe and of ſenſation in different ſyſtems, that we might be able to underſtand the abſolute and relative power of both. Although the ſubject is ſtill open for particular enquiry, we notwithſtanding poſſeſs facts ſufficient to draw a concluſion that the moſt rational ſyſtems are endued with a greater proportion of brain than the leſs rational, and that the brain of rational beings in general is proportion-

proportionably larger than the moſt inſtinctive. The ſkull of a white is conſiderably larger than that of a black, of an African than of a monkey, of a monkey than of a dog, of a dog than of a ſheep, or of an ox. The diſproportion increaſes in an amazing degree as we deſcend in the ſcale of rational beings, more eſpecially in fiſh, in amphibia, and finally in the inſect tribe. In the inſect tribe the brain merely conſiſts of a ſingle nerve; in the amphibia, as the turtle, the brain does not bear the proportion of one part to 800 of the whole.

The brain * of the ſhark does not weigh three

* *Le cerveau* a differentes proportions dans divers animaux. Il n'eſt pas grand dans les oiſeaux à proportion du corps: cette proportion eſt beaucoup plus petite dans le bœuf & dans le cheval; le ſinge, animal ruſé & adroit, a un grand *cerveau*. Les animaux ruminans en ont moins que l'homme, mais plus que les autres brutes; comme on le voit en comparant les cerveaux de la chevre, de l'élan, avec ceux du lion & du linx. Il eſt petit dans les animaux qui ſe battent; car ils ont des muſcles temporaux fort epais, qui étréciſſent leur crâne en comprimant, ſous la forme d'un plan incliné & cave, les côtés que nous avons ronds & ſaillans en dehors. On a donc raiſon de dire qu'un petit cerveau eſt la marque non de l'imbécilité mais

three ounces, although the animal itſelf is generally 300 pounds weight.

The brain of ſheep, with reſpect to the whole weight of the body, bears the proportion of one to 150.

In a dog the proportion is leſs: it is as one to 100.

As we aſcend in the general ſcale of rational beings, the magnitude of the brain bears an

mais de la férocité. Ce viſcére eſt beaucoup plus petit dans les poiſſons que dans les quadrupedes: le requin, qui peſe trois cents livres, n'a pas trois onces de cervelle: elle eſt copieuſe dans les eſpéces qui paroiſſent plus ruſée, telle que veau marin. C'eſt ſi peu de choſe dans les inſectes, qu'on ne peut ſavoir ce qui fait le cerveau: on ne voit que la moelle de l'épine ſeule, qui paroît dégénérer uniquement dans les nerfs optiques: dans l'éphemere, l'eſcarbot, l'abeille, le cerveau n'eſt au plus qu'une petite particule pas plus groſſe qu'un ganglion de la moelle épiniere, comme dans le chenille, dans l'hermite, dans les vers à ſoie. L'homme, le plus prudent des animaux, a le plus grand cerveau: enſuite les animaux que l'homme peut inſtruire, & enfin ceux qui ont très peu d'idée, & des actions de la plus grande ſimplicité, ont le plus petit cerveau. Mais eſt-on robuſte, en égard à la quantité du cervelet? Cela eſt vraiſemblable: l'expérience nous manque cependant ici; ce qu'il y a de certain, c'eſt que l'homme, fait pour avoir tant d'idée, n'eut pu les contenir dans un plus petit cerveau.—Dict. Raiſonné, tome ſecond.

increaſed

increafed and ftrongly marked proportion to the fize of the fyftem in general.

In the African, it is as one to 54.

In an European, as one to the 50th part of the fyftem all together*!!!

It is a matter of great difficulty to point out the particular periods when the organs have attained a fufficiency of evolution to difplay the fpecific powers they contain, when the dawn of reafon appears, until it is fully perfected.

It is probable that it is as progreffive as the evolution which the organs fuftain, from the fœtal and infant ftate to the periods of manhood and of old age. In the fœtal ftate the energy of reafon cannot exift, becaufe the living principle is employed in evolving the organs fubfervient to its ufe. During infancy

* That the fkull of the European is confiderably larger than that of the African, has been afcertained by a number of comparative experiments made by a friend of mine, whofe anatomical knowledge and accuracy in inveftigating anatomical fubjects I depend upon, and value more than my own. The fkull of an African was compared with thirty-fix different European fkulls, and they were all found to be uniformly and confiderably larger; and on filling them with water, the latter were found capable of containing a much larger quantity than the former.

it cannot be perfect, becaufe the organization of the brain is not yet completely attained: it is only at the period of manhood, when the whole is completely and perfectly evolved, that it becomes fitted to receive, and to convey the full energy of the mind. This aptitude continues to fubfift fo long as the health and ftrength of the fyftem remain: but when the vital organs lofe their energy and vigour, either from difeafe or the preffure of age, the organs of fenfe, of confcioufnefs, and of voluntary motion become gradually impaired; they lofe the aptitude they poffeffed, and become as unfit to receive from the mind within the volition it is wont to impart, as the organs of fenfe are unable to receive the impreffion from without, and to communicate them to the brain within. Hence it is that corporeal decay is always accompanied by a diminution of mental energy, to the total privation of it. It is not therefore furprifing to have feen the moft intellectual men ultimately become the greateft ideots, fuch as Sir Ifaac Newton, Dean Swift, Lord Mansfield, &c. &c.

Since then the perfection of the organs in man is progreffive from the fœtal and infant ftate

ftate to the period of manhood and of old age; it muft follow, I fay, that the condition of the one fhould be totally different from the condition of the other *.

If we examine the inclinations that arife in infancy and youth, when the rational and irrational principles are contending to affert their refpective powers; the irrational to preferve its dominion over the whole frame, by preventing the energy of the rational: on the contrary, the rational to come forth from a ftate of dormant capacity into action, and to

* The principles of Life or Mind are as feparate from the matter into which they are received, as an electrical machine is feparate from the hand by which it is moved. Matter, of whatever form it may be, has no more the power of organizing itfelf, than the electrical machine has by itfelf the power of producing the phænomena of electricity It is only when matter that is fitted, and which poffeffes the aptitude to be acted upon by the principle of Life, that it becomes converted into organs, and thefe organs employed by the living principle as inftruments of its action, by means of which the various phænomena of living action are difplayed. It is only when the temperature of the air is fitted for the action of the electrical machine, that electric fire can be produced; and that the electrician, by virtue of the art he poffeffes, is able to modify that fire by various experiments into various fhapes.

direct the organs subservient to its use—Human Life seems then to be characterised by a versatility and mixture of disposition, by sudden starts of action and passion, of grief and of joy; but as the system proceeds in its evolution, the organs of volition become better fitted to receive and to convey the attributes of mind. The energy of the living principle decreases with respect to growth; the capacity of the rational begins to increase: instead of the voluntary organs following the calls of appetite, they become subservient to the dominion of reason. Man thus become a rational being, exercises and improves the faculties of his mind, for the perfection of his nature; he feels conscious that the chain is broken by which he was linked with the brutish part of the creation. Instead of the voluntary organs being subservient to the gratification of the appetite, and the mere impulse of animal wants, they become the tractable instruments for reason to employ—ready to obey its call, but not to command it. It is then that we behold genius evolve and spring forth from its state of captivity—sciences and arts—the acquisition of learning, and the exercise

ercise of the moral virtues, the consequent effects of education calling forth the latent wisdom resident in the soul, and by which that wisdom is properly and rightly directed. The inferiority of the organic powers in man, with respect to those the higher order of brutes possess, whether we compare his faculties of motion, or restoration of strength and resistance, with theirs, evidently proves that a mere animal existence is not his true destination; it is by the energy of his reason alone that he is able to employ the voluntary organs with which he is endowed, as the instruments of his will, to relieve the afflictions, to obtain and distribute the comforts of human life. It is by the exercise of the same power that he is able to contemplate on the good, that he may resist the bad; that whilst the mind is often excited by the organs of sense, and the appetite of animal wants, he is able to resist and subdue, and frequently to act in opposition to them. Reason makes the animal fast when it is in want of food, it frequently compels the organs to take in food offensive and nauseous to the sensitive power; it exposes the system to the inclemency of the seasons, and to various dan-

 gers;

gers; it makes it ſubmit patiently to labour and fatigue, and even to death itſelf. "*Decus et decorum eſt pro patria mori.*"

Seeing then that the true deſtination of man is to lead a rational life; we evidently ſee the cauſe why he is inferior in his corporeal frame not only to brutes, but to vegetables; his frame more indigent, his organs of ſenſe ſmaller, and infinitely more ſterile than theirs. We muſt therefore conclude, that the final cauſe of human exiſtence is not the propagation of the ſpecies alone, as in vegetables; the propagation of the ſpecies, and the gratification of the appetite, as in brutes; BUT THAT IT IS THE PROPAGATION OF THE SPECIES, THE GRATIFICATION OF THE APPETITE, BUT MORE ESPECIALLY THE PERFECTION OF HIS MIND.

CHAP.

CHAP. XIII.

OF UNIVERSITIES.

Of the means by which the final cauſe of human exiſtence is attained.

IT has been with a view of attaining this higheſt and moſt perfect deſtination of man, that eſtabliſhments have been formed, where the accumulated wiſdom of all men, in all nations, and in every age, might be collected by a few men in one age, and reſiding in one place; the univerſality of whoſe knowledge has given the name of UNIVERSITY to the place of their abode. Theſe learned men, profeſſing to teach the wiſdom they poſſeſs, are called PROFESSORS; their eſpecial object is to impart knowledge to the ignorant, and to teach thoſe that have the capacity to be taught. The neceſſity of ſuch eſtabliſhments in a Chriſtian country muſt be particularly apparent, in order that the Chriſtian religion may be preſerved in its ſtate of original purity; that an unity of doctrine may be learned by the miniſters

nifters who are defigned to teach; and that the people at large may participate of the wifdom of the few. Without fuch eftablifhments the Chriftian doctrine would be the doctrine not of Chrift, but of any particular fet of men, as we frequently behold it amongft thofe who take the ignorance of their reafon for their guide, inftead of the wifdom of revelation. It is thus that we fee Unitarians and Unitarian Chriftians that deny the divinity of Chrift, that believe him to have been a perfect man, but deny that he was a perfect God;—Unitarians, pretenders to deifm, who deny the purifying influence of grace, fanctification by faith, redemption by atonement;—Materialifts who deny the immortality of the foul, and a future ftate of reward and punifhment: it is thus that we behold *nothingarians* who difbelieve every thing, and who believe in nothing. This clafs of men are not fo abundant in this as in many other countries—in America, and efpecially in Carolina, and amongft the Northern Southern men in Virginia; there they actually form a clafs, not of non-defcripts, but of thofe that actually go under that *Nothingarian* appellation.

CHAP.

CHAP. XIV.

OF THE COLLEGE OF PHYSICIANS.

The neceſſity of colleges for medicine not ſo eſſential as for theology—the cauſe why—the benefit, notwithſtanding, produced by their inſtitution—bye-laws eſtabliſhed in oppoſition to the original charter—men of the greateſt merit conſequently excluded from being eligible as fellows or licentiates, whilſt thoſe of no profeſſional merit become eligible alone, &c. &c. &c.

IT was, no doubt, with a view of attaining the ſame end, that colleges for the different branches of medicine were founded, honorary and pecuniary rewards allotted to profeſſors, and particular privileges granted to graduates, where public merit might be rewarded, and latent wiſdom openly diſtinguiſhed. The neceſſity of ſuch eſtabliſhments is not ſo great in arts and ſciences as it is in theology. In theology, the object is to preſerve, not to improve the doctrine; it is to make men learn what has been already proclaimed, and not to invent a new ſyſtem. On the contrary, in arts and ſciences, the object is not only to learn what is already known, but to improve upon that

that knowledge, to explore new branches of ſcience, and bring the whole to a ſtate of perfection. At the time when theſe colleges were founded, the ſtate of ſcience was totally different from what it is now; they poſſeſſed a perfect monopoly of knowledge, and there were no eſtabliſhments formed in London, or other parts of England. At this preſent time the caſe is completely reverſed; there is a monopoly of knowledge in London, and a perfect ſtate of ſterility in the colleges (I mean with reſpect to our profeſſion). Notwithſtanding this condition of things, the Fellows who have the controul over the affairs of the college, inſtead of admitting the meritorious to participate in the dignity attached to the eſtabliſhment to which they belong, monopolize the whole advantages to themſelves, and damp the ardour of purſuit, by excluding men from attaining profeſſional honour by means of profeſſional merit.

The College of Phyſicians, by virtue of its charter, has not only the privilege of examining medical men, Fellows of the different univerſities of Oxford and Cambridge *, with

* I muſt refer the reader to a very eloquent and able Expoſure of the Uſurpation of the College, written by Dr. Ferris.

reſpect

reſpect to their qualification in their profeſſion; but they have a right alſo to ſummon any members of foreign univerſities, and prevent them from practiſing in London, or within the bills of mortality, if upon examination they are deficient in profeſſional knowledge. The charter that granted the College theſe important privileges, had for its object, the prevention of empyrics from the practice of medicine, and the laudable deſire that every man ſhould give proper teſts of his acquirements before he was allowed to practiſe.

At this period the art of medicine was in the moſt barbarous ſtate that can be conceived: but after the College was eſtabliſhed, and certain teſts made requiſite to enable phyſicians to practiſe, an inducement was held out for men of dignity and abilities to engage in the ſtudy of it; the hoſt of empyrics conſequently diminiſhed and almoſt diſappeared, and the advantages were very ſoon felt and acknowledged. It was about this time that the immortal Harvey diſcovered that the blood was in a conſtant ſtate of circulation, in the living ſyſtem. Inſtead of Engliſh ſtudents emigrating to foreign univerſities for the purpoſe of being taught

firſt

firft principles that were falfe, viz. that the blood was dead and ftagnant, foreign ftudents came to England with a view of learning principles that were true.

The increafe of medical practitioners in this country foon began to excite fome degree of jealoufy in the Fellows of the College: they not only found competition, but a diminution of revenue; they therefore applied to, and obtained from, Parliament the power of making certain bye laws, not in oppofition to the fpirit of the original charter, but with a view of extending its operation. So far however from adhering to this principle, the Fellows have multiplied the bye laws of the College in fuch a manner, that, inftead of profeffional merit being the road to profeffional honour, profeffional honours are now the real and true attributes of profeffional ignorance.

Students who have gone through their regular apprenticefhip, who have entered in fome of the London hofpitals, where they have become dreffers, attended all the different claffes under the moft able teachers, after having diffected for two, three, or four years,—become phyficians' pupils, and had the whole range

range of the hofpital for the application of phyfiological principles to the pathology of difeafe, are not only difqualified to become Fellows but Licentiates alfo. Not thefe only, but intelligent, and in many inftances learned practitioners, Members of the Corporation of Surgeons, or of the Apothecaries Company, who have devoted the whole of a long life to the purfuit of fcience, and grown grey-bearded in the practice of medicine, are equally condemned as unworthy of that honour.

After feeing what knowledge it is that difqualifies a man to become either a Fellow or a Licentiate of the College, it remains for me to fay, what are the effential attributes by which that exalted and diftinguifhed honour is to be obtained. A man muft have ftudied, or at leaft paffed, two years at one of the foreign univerfities, Edinburgh, Glafgow, &c. (London is not confidered as an univerfity) before he can be permitted to offer himfelf for examination as a Licentiate; and finally, it is neceffary that he fhould have regularly matriculated at either of thofe fountains of medical wifdom, Oxford or Cambridge, for the nominal period of fourteen years, before he can

be admitted within the pale of a fellowſhip in the Royal College of Phyſicians of London. It is very true, that with the exception of young gentlemen, who are natives of thoſe cities, Students occaſionally reſort there only for the purpoſe of keeping terms; and many abridge their period of ſervitude from fourteen nominal years, to three of abſolute attendance. Keeping terms in this way is called *term trotting*, and the graduates themſelves have received the appellation of *Term Trotters*. This is the period thought neceſſary before apprentices to ſurgeons and apothecaries are deemed qualified either to bleed, or adminiſter an enema to a patient; whilſt, on the contrary, the matriculated ſtudents of Oxford and Cambridge, who have learnt anatomy without diſſection, ſtudied medicine by ſeeing the healthy, and the practice of it without viſiting the ſick, are deemed *bona fide* alone qualified to be at the head of our profeſſion. Is it then ſurpriſing that the College of Phyſicians is dwindled to nothing; and the only dignity attached to the Fellows of it is but a name; that whilſt they are flattering and complimenting each other in their orations, they are abuſing

abufing the Licentiates, and holding at a diftance men of fuperior medical knowledge to themfelves?

Motives of perfonal regard prevent me from difcuffing the abilities of the different Fellows. It has been thought, that the publication in France of *the Livre Rouge with Notes*, was very inftrumental in exciting the contempt of the nation againft the haute Nobleffe. If the profeffional abilities of the Fellows of the College were fcrutinized, it is very probable that a fimilar lot would befall them.

The great Leviathan of the College, * * * * * * * *, before his death, is reported to have declared that there was no good in phyfic, although he realized eight or ten thoufand guineas annually by the adminiftration of it. But here I ftop for the prefent. I fhall merely conclude by applying to thefe gentlemen the memorable words that came from the elegant pen of Junius upon a former occafion: "The feathers that adorn the *College* bird fupport his flight: ftrip him of his plumage, and you fix him to the earth *."

* It is proper to obferve, that that learned and elegant writer Dr. Knox, who was a Fellow of St. John's College,

lege, Oxford, has turned king's evidence, and expofed the mode of college education. "The world at large, who hear of colleges, like palaces, devoted to learning, of princely eftates bequeathed for the fupport of Profeffors, of public libraries and fchools for every fcience, are difpofed to view the confecrated place in which they abound with peculiar veneration. Accidental vifitors alfo, who behold the fuperb dining halls, the painted chapels, the luxurious common-rooms, the elegant chambers, and a race of mortals in a peculiar drefs ftrutting through the ftreets with a folemn air of importance; when they fee all the Doctors, both the Proctors, with all the Heads of Colleges and Halls, in folemn proceffion, with their velvet fleeves, fcarlet gowns, hoods, black, red and purple, cannot but be ftruck with the appearance, and are naturally led to conclude, that here at length wifdom, fcience, learning, and whatever elfe is praife-worthy, for ever flourifh and abound.

"Without entering into an invidious and particular examination of the fubject, that notwithftanding this profufe expence, the public has not, of late at leaft, been indebted for the greateft improvements in fcience and learning to all the Doctors, &c. laid together. That populous city London, and that region of literary labour, Scotland, have feized every palm of fcholaftic honour, and left the fons of Oxford and Cambridge to enjoy fubftantial comforts in the fmoke of the common or combination rooms. The Burfar's books are the only manufcripts of any value produced in many colleges, and the fweets of penfions, exhibitions, fines, fellowfhips, and petty offices, the chief object of academical purfuit.

"The youth whofe heart pants for the honour of a Bachelor

Bachelor of Arts degree, muſt wait till four years have revolved, and is obliged, during this period, once to oppoſe, and once to reſpond, in diſputations held in the public ſchools: this oppoſing and reſponding is termed, in the cant of the place, *doing generals* together. Arguments are procured, which have been handed down from generation to generation, on long ſlips of paper, and conſiſt of fooliſh ſyllogiſms on fooliſh ſubjects, of the formation or ſignification of which, the reſpondent and opponent ſeldom know more than an infant in ſwaddling clothes. A liceat is obtained from the Regent Maſter, and the doughty diſputants go into a large duſty room full of dirt and cobwebs, with walls and wainſcots decorated with the names of former diſputants, who, to divert the tedious hour, cut out their names with their pen-knives, or write verſes with a pencil. Here they ſit in mean deſks oppoſite to each other, from one o'clock till three. Not once in 100 times does an officer enter; and if he does, he hears one ſyllogiſm or two, then makes a bow, and departs as he came and remained, in ſolemn ſilence. The diſputants then return to the amuſement of cutting the deſks, carving their names, or reading Sterne's Sentimental Journey, or ſome other edifying novel. The parties have then a right to the inſignia of *Sophs*, but not before they have been formally *created* by one of the Regent Maſters, before whom they kneel, while he lays a volume of Ariſtotle's Works on their heads, and puts on a hood, a piece of black crape hanging from their necks down to their heels. The next exerciſe is called *doing jurament*, which being interpreted, ſignifies *the evading of one's oath*. A few more trifling forms are neceſſary before a Bachelor's degree is obtained, and the greateſt dunce uſually gets his *teſtimo-*

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nium ſigned with as much eaſe and credit as the fineſt genius.

"Every candidate is obliged to be examined on the whole circle of the ſciences by three Maſters of Arts, *of his own choice*. The *ſchemes*, as they are called, are little books, containing forty or fifty queſtions in each ſcience, as handed down from age to age, from one to another. The candidate to be examined, employs three or four days in learning them by heart; and the examiners, having done the ſame before him, know what queſtions to aſk. After the candidate has diſplayed his univerſal knowledge of the ſciences, he is to diſplay his ſkill in philology. One of the maſters therefore deſires him to conſtrue a paſſage in ſome Greek or Latin claſſic; which he does with no interruption, juſt as he pleaſes, and as well as he can. He is next required to tranſlate familiar Engliſh phraſes into Latin, droll queſtions are put on any ſubject, and the puzzled candidate furniſhes diverſion by his awkward embarraſſment. The queſtions I have known on this occaſion to conſiſt of an enquiry into the pedigree of a race-horſe, &c. &c. &c. The teſtimonium is ſigned by the Maſter of Arts—he appears in the Convocation-houſe, takes an abundance of oaths, pays a ſum of money in fees, and after kneeling down before the Vice Chancellor, and whiſpering a lie, riſes up a Bachelor of Arts.

"The examination for Maſter of Arts is performed exactly in the manner above deſcribed, and, though repreſented as very formidable, is ſuch an one as a boy from a good ſchool juſt entered might go through as well as after a ſeven years reſidence. Few however reſide; for the majority are what are called *term trotters*, that is, perſons who only keep the terms for form's ſake, or ſpend ſix or eight

eight weeks in a year in the univerfity, to qualify them for degrees. The declamations would be ufeful exercifes, if they were not always performed in a carelefs and evafive manner. The lectures are always called WALL lectures, becaufe the lecturer has no other audience but the walls: indeed he ufually fteals a fheet or two of Latin out of fome old book, no matter the fubject: this he keeps in his pocket, in order to take them out and read away, if a Proctor fhould come in: but otherwife he fits by himfelf, and folaces himfelf, if he pleafes, with a book, not from the Bodleian but the circulating library.

"After all thefe important exercifes and trials, &c. &c. the academic is honoured with a Mafter's degree, and fallies forth into the world with this undeniable paffport to carry him through it with credit.

"Exercifes of a nature equally filly are performed in a fimilar manner for the other degrees."

N. B. I have omitted tranfcribing an account of the Bacchanalian Feafts that are common upon thofe occafions: thefe, and other incidents of a like nature, may be learnt by an appeal to the book itfelf.

Vide Knox's Effays, Moral and Literary, No. 57, p. 155.

CHAP. XV.

OF THE CORPORATION OF SURGEONS.

Ruinous ſtatement of the Corporation made by the Warden—application made to parliament to retrieve its affairs—the application reſiſted with ſucceſs—the cauſes why, &c. &c. &c.

HOW ſhamefully the Corporation of Surgeons has anſwered the end of its inſtitution may be collected from the Report made by Mr. Gunning himſelf (the Warden) to the Court of Aſſiſtants.

After having examined and pointed out the impaired and periſhing condition of its finances, notwithſtanding the large ſums of money that had been received, he tells them, that they have a theatre without lectures, a library without books, a committee-room uſed as a dining-parlour, an empty purſe for charitable donations, &c. &c. &c.

It was impoſſible that a corporation perverting and inverting, as it did, the final cauſe of its exiſtence, could long ſubſiſt. It has therefore

therefore gradually crumbled to decay; the theatre has been fold, and the corporation has been finally decompofed like a putrid and mortified body into its conftituent parts; fo that at this moment the profeffion to which I have the honour to belong is compofed of members without a corporation.

Application was made to Parliament to reanimate the corpfe by granting new powers to it. The application failed, partly becaufe it was thought that thofe who had contributed to this act of fuicide were improper perfons to point out the means of its refufcitation. The body of Surgeons is therefore employed at this time in planning a model for the approbation and fanction of Parliament, that it is hoped will ftamp dignity to the profeffion, impart knowledge to its members, and diftribute benefit to mankind.

It were to be wifhed that a ftanding Court of Examiners fhould fubfift, with a permanent falary eftablifhed, and that the examination of pupils fhould be a real and not a nominal one. When I was examined as a furgeon, I was examined by a notorious quack (fince dead), who ufed to proftitute his name

in the newſpapers by writing long letters to the venders of quack medicines, and recommending their general exhibition. Young as I then was, I thought it my duty to complain of it to the Court before whom I had the honour to paſs, and to requeſt that this gentleman ſhould not ſign my diploma. I was very reſpectfully informed by Mr. Warner, the warden, that although my application was thought a juſt one, the Court had not this preventative power. The quack continued until the time of his death to atteſt the diplomas of young Surgeons, by which they are eſpecially characterized for having received a regular and ſcientific education, and conſequently diſtinguiſhed from the tribe of empyrics to which the examiner himſelf belonged.

AS to the Apothecaries Company, it muſt be conſidered as a company deſigned for traffick and merchandiſe, rather than for ſcience. The good it does (and that good is certainly great) extends to the importation of the beſt medicines, which it vends to the public at an equitable price. It does not however appear that

that the exertions of this company have contributed in any confiderable degree either to the perfection of the practical part of chemiftry, or to meliorating the pharmaceutic department; it may rather be confidered as a Difpenfary to the Fellows of the College of Phyficians, and as more immediately under their controul.

After having expofed the errors of thefe different eftablifhments, it may perhaps be expected that I fhould point out the means by which they can be amended. The eftablifhments of themfelves are good, and it is the conduct of thofe only who fuperintend them which is bad. Inftead of acting conformably to the principles of the inftitutions, they live in conftant violation of their precepts. It is not new laws that are wanted, fo much as the proper execution of the old. The evils that exift are evils of omiffion more perhaps than of commiffion. Let thofe who have the management of the Surgeons' Company act with diligence and zeal; and notwithftanding the impaired and impoverifhed ftate of its finances,

we

we ſhould ſoon ſee it have lectures without a theatre, books without a library, committee-rooms without dining-parlours, and a full purſe for the indigent and needy, inſtead of an empty one.

When men are animated with a laudable ſpirit to further the end of the inſtitution to which they belong, we frequently behold great objects attained by means apparently inadequate and inſufficient : on the contrary, inſtead of looking forward to the attainment of the final cauſe, they do not think of it; they generally employ the means to perſonal purpoſes inſtead of general ones; to private advantage inſtead of public good.

Animated as I feel myſelf to be with the love of my profeſſion, and deeply intereſted in its welfare, I ſincerely hope to ſee the government of it placed on a reſpectable eſtabliſhment, and the governors of it reſpectable men : it is then, and then only that we may hope to ſee it attain the end for which it was deſigned.

It is however vain to hope that public adminiſtrations can be well managed whilſt the conduct of individuals of which they are compoſed

posed is bad. If the parts of a building are defective, it is impossible that the whole can be good; it is therefore a reformation in private morals that must be first attempted, before we can expect to see large masses of men acting and co-operating together in the acquisition of knowledge, and in the general diffusion of it. The means however are evidently the same in both, and consist in education and instruction.

CHAP. XVI.

OF THE MEANS BY WHICH INDIVIDUALS ATTAIN THE FINAL CAUSE OF THEIR EXISTENCE.

Difference between education and instruction—method of proceeding scientifically in the investigation of any subject—axioms the basis of knowledge—leading to our knowledge of causes, whence effects are produced, &c. &c. &c.

EDUCATION and instruction are the means by which the final destination of man is attained, and by which the necessary media

dia are found to connect the dawn of reafon to the full perfection of it.

Education conftitutes the genus, of which *Inftruction* is the fpecies. Education comprehends the general habits, manners, and cuftoms of the inhabitants of a country, and is the caufe that every nation has a national character. On the contrary, inftruction is limited to the particular direction given to genius; it is the caufe why particular claffes of men have the fame habits, and different individuals have particular propenfities and purfuits. Education bears the fame relation to inftruction, that a whole does to a part, or that memory does to recollection. Memory reprefents things paft in general; recollection reprefents things paft in particular.

In every fpecies of knowledge whatever, the moft fimple muft be attained before the moft compound: it is in learning this fimple particular knowledge, for which early inftruction is efpecially defigned, that we may be able to comprehend and attain knowledge univerfal. It muft be obvious to every reflecting mind, that all knowledge whatever, whether it appertains to fcience or to art, is reducible to

general principles, as certainly as it is obvious that every effect is the consequence of some producing cause. Many men who have not learnt these principles, can frequently assign reasons, or the *cause why*, for the effects they behold: they seem intuitively to possess a degree of science, and attain its rules by chance, which instruction is especially designed to unfold. Mr. Harris therefore very accurately observes, that in the investigation of principles, we are first taught to learn, that every science, as arithmetic, geometry, music, astronomy, &c. may be resolved into its theorems; every theorem into its syllogism; every syllogism into its propositions; and every proposition into certain simple or single terms.

If we were to begin before we have attained a knowledge of simple terms, which are in themselves irresolvable, it is evident we should *begin* in the *middle*; and if we were to begin at the theorem itself, before having attained a previous knowledge of a syllogism and of a proposition, we should begin not merely at the middle, but at the very *end*. It is therefore very obvious, that simple terms constitute the *punctum saliens*, from whence our knowledge

knowledge ought to commence, the firſt which ought to be attained; and that beginning with any other is an inverted order of being taught.

It is by the previous attainment of this ſimple knowledge, that we are qualified to learn that which is more compound. Between the moſt ſimple and the moſt compounded knowledge, there exiſts a connecting medium (which ought to be learnt and underſtood), by which the extreme parts, the beginning and the end, are united, ſo as to form one whole. It is in this inveſtigation that the office of ſcience conſiſts, and which forms the true object of its purſuit.

Science therefore begins from principles, and proceeds through proper media to the concluſion, from cauſe to effect, from things general and univerſal to things particular and occaſional.

Things univerſal, or principles, conſiſt in ſimple undeniable truths, reſpecting the identity of which, every one who has the poſſeſſion of common ſenſe, muſt admit, and cannot deny, ſuch as axioms in general; the ſecond conſiſts in the propoſition and theo-

rem,

rem, which are deduced from thofe axioms, and which are immediately founded on them; and finally, the third is the conclufion itfelf, by which the *thing particular* is deduced from the *thing univerfal.*

The firft conftitutes the bafe, the fecond is the road, and the third is fcience itfelf; it is the perfect apprehenfion of the parts proceeding and depending on each other, that forms the fcientific knowledge of a fubject, or the knowledge of effects, as arifing and proceeding from their producing caufes. This is the plan which I have adopted in the inveftigation of the fubject I am endeavouring to explain. I firft afcertained the general and particular properties of Common and of Living Matter, and compared them with each other; the univerfal famenefs of effects that the former difplayed, I found to be totally different from the univerfal changes of the other. I therefore concluded, that the caufe by which the effects were produced in the one, was different from the caufe by the power of which the alterations in the other are occafioned. The power or caufe by which Common Matter is governed, appeared to me an univerfal one,

becaufe

becaufe all Dead Matter underwent a regularity in its changes. On the contrary, the power by which Living Matter was governed appeared to me a particular one, becaufe every living fyftem had its particular mode of action.

After having afcertained what Common Matter was and what it was not, I foon faw what Living Matter actually was not, and from thence was led to learn what it was, and then afcertained the nature of the caufe of which it was the effect. It was thus that I attained my knowledge of Life, and of Living Matter. After having acquired a knowledge of this power by which Living Matter is univerfally governed, I proceeded to inveftigate the *general properties* of Living Matter, and afterwards thofe that were *particular and diftinct—action in general before action in particular.*

The anatomical ftructure of the animated fyftem I faw conftituted the connecting medium, between the effects that flow from it, and the living principle by which that ftructure was produced; it is the power from which organization is formed and its actions derived; which I have denominated LIFE,

which

which is eſſentially ſimple and irreſolvable, and which is therefore properly denominated a *principle*, comprehending within itſelf the *form* of the organization and the primary power by which action is produced.

In taking a general review of the particular ſyſtems of which the whole chain of animated exiſtence was compoſed, it appeared a ſelf-evident truth, that the particular actions of their organs all tended to one ultimate end; in vegetables, to the propagation of the ſpecies; in brutes, to the propagation of the ſpecies, and the gratification of the appetite: in man, it was not the propagation of the ſpecies, or the gratification of the appetite, by which he appeared to me ſignalized and diſtinguiſhed, ſo much as by the perfection of his Mind. Having aſcertained theſe important truths, it was neceſſary for me to examine the organization which was employed to attain and fulfil theſe ends. I was conſequently led to obſerve the diſtinction that ſubſiſts between vegetables and animals, between brutes and the human ſpecies.

In vegetables, the wonderful and extended degree of living power, and apparent privation of organs of ſenſe; in brutes, the apparent magnitude

nitude in the organs of ſenſe, and the exiſtence of a ſmall brain, and diminution of aſſimilating power; in the human ſpecies, the magnitude of the brain, the comparative ſmallneſs of the organs of ſenſe and of the digeſtive faculty, evidently ſhewed that it was the power by which theſe organs were made to act, and the ultimate action of theſe organs themſelves, which reſpectively conſtituted the true and final cauſe of their exiſtence. I therefore diſcovered the CAUSE of their different properties and purſuits, and why they tended to different ends *.

If

* I ſhall hereafter proceed to trace what are the objects that man ought to purſue, by which his end may be accompliſhed. I ſhall then deſcend to things particular, and ſhew the MANNER HOW. This will lead to the particular examination of the Anatomy and Phyſiology of theſe various ſyſtems. And beginning with the moſt ſimple, I ſhall end with Man, the moſt compounded and complicated of the whole; until he has gone through the whole of his exiſtence, and, it is hoped, attained the end for which he was created; and finally becomes decompoſed and reſolved into a common ſtate. It is at this point where the duty of the Phyſiologiſt terminates, and where the Chemiſt and Natural Philoſopher aſſume their functions: the Chemiſt, to inveſtigate and examine the particular and ſenſible properties of this matter; the Natural Philoſopher, to aſcertain the laws by which it is governed. Thinking, as I moſt

conſcientiouſly

If the end of human exiſtence depended on the extent and perfection of living power, human exiſtence would not only be inferior to the brute, but the brute itſelf would be inferior to vegetable exiſtence. If it depended on the perfection and extent of organs of ſenſe, the condition of the brute would be far ſuperior to the condition of man, becauſe the organs of ſenſe in the one are found to be far ſuperior to what they are found to be in the other. What man is there on the whole face of creation, that can imitate the fabric elaborated by the power of the bee *, or make a neſt equal

conſcientiouſly do, after the moſt diligent inveſtigation, the ſyſtem in preſent eſtimation to be an erroneous one, I ſhall proceed to conclude this work by inveſtigating the Newtonian Laws of Nature as they have been called; when I hope to prove, that Sir Iſaac Newton has had words put into his mouth which he never uttered, and meanings attached to the words he uttered which he never meant.

* When the bees begin to work in their hives, they divide themſelves into four companies; one of which roves in the fields in ſearch of materials, another employs itſelf in laying out the bottom and the partition of their cells, a third is employed in making the inſide ſmooth from the corners and angles, and the fourth company brings

equal to the moſt inſignificant animal? And finally, if the excellence of man depended on the

brings food for the reſt. They however occaſionally exchange their taſks; thoſe that have been at work being permitted to go abroad, and thoſe that have been in the fields already, take their places. They ſeem even to have ſigns by which they underſtand each other: for, when any of them wants food, it bends down its trunk to the bee from whom it is expected, which then opens its honey-bag, and lets ſome drops fall into the other's mouth, which is at that time opened to receive it. Their diligence and labour are ſo great, that in a day's time they are able to make cells, which lie upon each other, numerous enough to contain three thouſand bees.

In the plan and formation of theſe cells they diſcover a moſt wonderful ſagacity. In conſtructing habitations within a limited compaſs, an architect would have three objects in view: firſt, to uſe the ſmalleſt poſſible quantity of materials: ſecondly, to give to the edifice the greateſt capacity on a determined ſpace: and, thirdly, to employ the ſpot in ſuch a manner that none of it may be loſt.

On examination, it will be found that the bees have obtained all theſe advantages in the hexagonal form of their cells: for, firſt, there is an œconomy of wax, as the circumference of one cell makes part of the circumference of thoſe contiguous to it: ſecondly, the œconomy of the ſpot, as theſe cells, which join to one another, leave no void ſpace between them: and thirdly, the greateſt capacity or ſpace, as, of all the figures which can be contiguous, that with ſix ſides gives the largeſt area. This thriftineſs

the ſtrength and power of his organs; there is not an horſe, or an aſs, that might not claim the ſuperiority over him.

Seeing

thriftineſs prompts them to make their ſides thin, and yet ſufficiently ſolid for the ſcantineſs of their materials. The entrances of the cells which are moſt liable to injury at the entrance, theſe the bees take care to ſtrengthen, by adding quite round the circumference of the apertures a fillet of wax, by which means this mouth is three or four times thicker than the ſides, and they are ſtrengthened at the bottom by the angle formed by the bottom of three cells falling in the middle of an oppoſite cell. The combs lie parallel to each other, and there is left between every one of them a ſpace, which ſerves as a ſtreet, broad enough for two bees to paſs by each other: there are holes which go quite through the combs, and ſerve as lanes for the bees, to paſs from one court to another, without being obliged to go a great way about. When they begin their combs, they form at the top of the hive a root, or ſtay to the whole edifice, which is to hang from it; and though they generally lay the foundation of all the combs, ſo that there ſhall be no more between them than what is ſufficient for two bees to paſs; they ſometimes place thoſe beginnings of two combs too far aſunder; and in this caſe, to fill up the ſpace ariſing from that bad diſpoſition, they carry their combs on obliquely, to make them gradually approach each other. Some of the bees run about beating the work with their wings and the hinder part of their body, probably with a view to make it more firm and ſolid; ſome are employed

Seeing then that we muſt abandon organic perfection and power as the final cauſe of human exiſtence, we muſt conclude, that it is the perfection of MIND on which it eſpecially depends. It is the particular nature of Mind, or rational principle, that ought ever to give the diſtinguiſhing characteriſtic between excellence and mediocrity; that ought to ſtrike out the individual from the ſpecies, and be-

in forming the cells, others again in poliſhing and perfecting thoſe that are new modelled: the poliſhers are not ſo deſultory in their operations as thoſe that make the cells; they work long and diligently, never intermitting their labour, excepting to carry out of the cell the particles of wax which they take off in poliſhing: theſe particles are not allowed to be loſt; others are ready to receive them from the poliſhers, and to employ them in ſome other part of the work. The materials out of which the whole fabric is compoſed, conſiſt of a powder obtained from the corolla of plants, and not yet brought to the ſtate of wax. It obtains the yellow farina by rolling itſelf within the flower, and quickly becomes covered with this duſt, which it ſoon after bruſhes off with its two hind legs, and kneads into two little balls: they alſo collect crude wax for food; and they are obſerved even in old hives to return loaded with ſuch matter, which is depoſited in particular cells, and is known by the name of Bee Bread, &c. &c. &c. This very curious account I have extracted from the *Encyclopædia Britannica.*

come

come the real and true ſource of difference in the attributes and eſtimation of different men. It is to the perfection of Mind reſident within, and not to the organs without; it is to the motives of Mind, and not to the ultimate effect produced by the organs as the mere inſtruments, that we ought to attach merit or diſgrace to the actions they perform. It is thus we conclude, that the wiſdom and temperance of age are better than the appetite and paſſion of youth; civil life better than ſavage; the man of ſcience better than the artiſt; the architect better than the labourer; and human exiſtence better than brutal.

The truth of theſe principles will evidently appear, if we proceed to examine the attributes of the human ſpecies when it ſubſiſts in a civilized and poliſhed ſtate, diffuſing dignity on itſelf, or when it grovels in a ſavage and barbarous condition: we ſhall then find, that the objects of its purſuits in the one are totally different from thoſe of the other.

In ſavage life, the gratification of the appetite, and adminiſtering to animal wants, are the ends to which all its actions tend, and for the attainment of which its inſtruction is

wholly directed. Savages are therefore taught to ſtring the bow and navigate the canoe; they are taught patiently to ſuffer labour and fatigue; to brave danger and even death itſelf: they poſſeſs theſe attributes in a moſt exalted degree, when perſonal ſecurity calls for exertions againſt perſonal danger, or when they are incited to the gratification of the appetite; they are therefore gluttons and drunkards, and habitually addicted to debauchery and licentiouſneſs. In civil life, the true objects of purſuit conſiſt in the evolution and perfection of the Mind; to ſubdue the appetite in the organs of ſenſe, and prevent the paſſions they excite. In ſavage life, the ſtrength of the corporeal frame is taken as the ſtandard of its perfection: all men therefore are equal, who are equally ſtrong; becauſe all are equally ignorant and fooliſh. In civil life, all men are on an equality who are equally wiſe and good, however unequal they may be in the organization of their frames. In ſavage life, the moral virtues are the offspring of corporeal wants, limited and confined to the individuals alone in which they exiſt. In civil life, the good that is done is not of a ſelfiſh or of a

perſonal

perſonal nature; it is eſpecially deſigned for the benefit of others, and the conſciouſneſs alone is retained of the bleſſings it beſtows.

Savage life has a conſtant tendency to ſtop at infancy as it proceeds to old age, and is conſequently a life of ſenſe without reaſon: on the contrary, civil life is a life of reaſon without ſenſe; wiſdom and virtue are the true objects of deſire; temperance and chaſtity the effects that from thence enſue. In ſavage life, the weak fall a prey to the ſtrong, and the women are ever the ſlaves of the men. Hence ariſes the cuſtom in barbarous countries, for ſome women, who feel the equality of their nature, but the inequality of their condition, to exterminate their female offspring as ſoon as born. The old and the infirm are deſerted by the State; and it is very uſual to end the exiſtence of thoſe who are unable either to provide for their own wants, or to take a ſhare in protecting the horde to which they belong.

In civil life, the ſtrong become the protectors of the weak; the men are the conſtant guardians and admirers of the women *, afford-

* In the one, the men are gentlemen, the women are ladies: in the other, the men are ſans culottes, the women are poiſſardes.

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ing relief to the indigent, hoſpitals of health to the ſick, aſylums for the decrepid and the old.

In ſavage life, the attachment that ſubſiſts between the parent and the offspring is the ſame in kind, although in degree perhaps more imperfect than we behold it in brutes. The attachment that ſubſiſts between brutes and their offspring continues in the moſt eminent and powerful degree, during the incapacity of the offspring to provide for its wants: as ſoon as the period is arrived when the offspring has attained a ſufficiency of growth and of ſtrength to protect itſelf, the attachment ends, and direct averſion begins. Thus it is we ſee pigs devour their litter, cats kill their kittens, and birds drive from their neſts the offspring they had incubated.

In ſavage life, the attachment between the parent and the offspring, although it may be equally ſtrong, gradually decreaſes like that of the brute, and ultimately becomes extinct: it is not therefore unuſual in ſome ſavage countries for children to deſtroy their parents, or for parents to deſtroy their children, when

they

they are incapable, either from decrepitude or the preffure of age, to provide for thofe neceffary wants which they continually experience. In civil life it is far otherwife: the attachment that fubfifts between the parent and the offspring is unlimited and irrefiftible, and gradually increafes by an increafe of age.

Yet man in a favage ftate is commonly faid to exift in a ftate of nature. If this fuppofition were as true as it is falfe, vice would be better than virtue; licentioufnefs better than chaftity; intemperance better than fobriety; ignorance better than knowledge; the perfection of the body better than the wifdom of the mind; vegetable exiftence better than brutal; and brutal exiftence better than human.

It is far otherwife. The beft formed and moft robuft fyftems are frequently the refidence of the moft imbecil and of the moft ferocious minds, as we behold in favage tribes in general, and in different individuals of different European nations.

On the contrary, the ftrongeft and the moft perfect minds are frequently refident in fyftems the moft rickety and mutilated, the moft

decrepid and deformed that can be conceived: need I quote particular inſtances, when the fact is found ſo generally to ſubſiſt in thoſe great luminaries of our country, Sir Iſaac Newton *, and Mr. Pope? Need I prove it by pointing out the various diſeaſes habitual to literary men, and the conſtant weakneſs they ſuſtain by exceſſive energy of the mind, by the inceſſant prediſpoſition of the body to diſeaſe, and of the actual exiſtence of diſeaſe itſelf, by what have been called mental paſſions; of the good, but eſpecially of the bad;

* It not only appears from the account we have of Sir Iſaac Newton's life, that he was frequently indiſpoſed from exceſſive application, and more eſpecially with an incontinency of urine, brought on probably from a forced retention of it when he was ſolving ſome important problem, and from long ſitting; but I had a frequent opportunity of ſeeing the identical obſervatory chair, or ſtar-gazing throne, in which he made all his diſcoveries: it reſembles a common arm chair rolling on caſtors; there are deſks for the ſupport of books at each arm; the arms themſelves are ſufficiently ſtrong without props beneath, ſo that Sir Iſaac could turn himſelf quite round, whilſt the chair remained unchanged in poſition: the bottom was covered over with black leather, the forepart of which was entirely corroded from the action of the urine upon it; the remainder was quite ſound.

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of hatred and of love; of fear and of devotion; of jealoufy, anger, &c.*?

Seeing

* We all know the influence of a timid mind in predifpofing the body to difeafe: it is univerfally acknowledged, that in places where contagious difeafes prevail, thofe who are fearful and apprehenfive of receiving the contagion are thofe who have the leaft power to refift its influence; and who, therefore, fall the firft victims to its effects: and, finally, in thofe who are feized with fudden and violent paffions of the mind, and that die in confequence, putrefaction is found immediately to take place.

It now remains for me to point out the various difeafes which different affections of the mind produce upon the brain, as the organs by which thofe affections are received and made manifeft: and, 2dly, of the effects that this affection of the brain produces on the animated fyftem, and the confequent derangement it fuftains.

I fhall merely ftate what is occafionally found to be true: that fudden ftarts of paffion, fuch as grief, joy, furprife, &c. have proved the caufe of afphyxia, or fudden death.

Affections of the mind, fuch as fear, furprife, joy, antipathy, pain, pleafure, à veneno become the caufe of fyncope, which is manifefted by a diminifhed, and fometimes a total fuppreffion of the motion of the heart. Vexation of the mind, and diforderly paffions of any kind, intenfe ftudy, or too clofe and too long continued application to bufinefs, are the exciting caufes which produce hypochondriafis, a difeafe which exifts in *tempera-*

ments

Seeing then the difference that ſubſiſts between ſavage and civil life, we can eaſily re-

mento melancholico, and is beſt known and defined by the enumeration of the following ſymptoms, *mœſtitia et metu ex cauſis non æquis*, *dyſpepſia cum languore*.

I have reverſed the order of the ſymptoms ſtated in the definition of Dr. Cullen, which ſtand thus, "*Dyſpepſia* "*cum languore*, *mœſtitia et metu*," &c. The hypochondriaſis, in conſequence of dyſpepſia, is only a ſymptomatic diſeaſe, the dyſpepſia in conſequence of hypochondriaſis is the ſymptom only, of which hypochondriaſis is the cauſe.

The derangement of the body which theſe affections of the mind produce, may be known by enumerating the various ſymptoms that are concomitant on dyſpepſia—a want of appetite, a ſqueamiſhneſs, ſometimes a vomiting, ſudden and tranſient diſtenſions of the ſtomach, eructation of various kinds, heartburn, pains in the regions of the ſtomach, and coſtiveneſs, &c.

Sudden fear, diſappointment or diſtreſs, ſudden and violent forces impreſſed upon the nerves of ſenſe; violent ſound upon the organs of hearing, exceſſive light upon the eye, &c. are the exciting cauſes which operate too ſtrongly upon the ſentient principle, and weaken and diminiſh, or aboliſh altogether its power over the brain and, voluntary parts: theſe cauſes produce deafneſs, blindneſs, loſs of taſte, or power of diſtinguiſhing or feeling the impreſſion of odours: it is farther manifeſted by the mind having loſt all power over voluntary parts: the loſs of this power is frequently accelerated by cauſes operating upon the mind, from the various paſſions I have above ſtated.

ſute

tute thofe wild and prevailing opinions, that fuppofe fenfual gratification to be the moft intenfe, and that infancy and youth are the appropriate periods for human happinefs. If thefe fuppofitions were true, the final caufe of man, inftead of being different, would be the fame as that of the brute: the perfection of man would confift in the gratification of his appetite, and not in the perfection of his mind; it would be a life of fenfe without reafon, inftead of being a life of reafon without fenfe.

The rational and intellectual powers of man decidedly prove that he has an higher deftination to attain than brutal appetite alone. It is the gratification of the appetite that conftitutes the true felicity of the brute, and in which the perfection of its nature confifts: but if the excellence of man confifts in the intellectual powers he poffeffes, then muft it follow that it is the proper exercife of his intellectual power on which his true felicity depends, and it is through thefe alone that he acquires the true perfection of his nature.

It was with a view of attaining this exalted condition, that Solomon, the wifeft of all the wife men, declared, that "train up a child

"in

"in the way he ſhould go, and when he grows "old he ſhall not depart from it;" and which Horace has paraphraſed thus:

> *Qui ſtudet optatam curſu contingere metam,*
> *Multa tulit, fecitque puer.*

Such is the comparative degree of power in the organs of ſenſe during infancy and youth, that the gratification of the appetite ſeems then to be the principal object of deſire: the impreſſions made upon thoſe organs are ſtriking and permanent, and in this reſpect the human ſpecies reſemble brutal exiſtence: it is with a view of emancipating the human ſpecies from this ſelfiſh and abject condition, that the mode in which he is trained becomes of the greateſt importance.

This is the period of imitation and of example; and when we caſt our eyes on the fate allotted to different claſſes of men, we ſhall at once be obliged to admit the force of their influence. There are ſome minds ſo totally vicious that no example can lead them into a courſe of virtue; and others again ſo originally good, that, like ſturdy oaks which overcome the force of hurricanes, they are able to reſiſt all allurements to vice.

This

This inherent power which the mind poſſeſſes of being taught, is called by Mr. Harris NATURAL CAPACITY, and is common to all men. The ſuperior facility of being taught, which *ſome* poſſeſs above the reſt, is called GENIUS. The firſt tranſitions or advances from *natural* power are called PROFICIENCY, and the end or *completion* of *proficiency* is called HABIT.

If ſuch *habit* be converſant about matter purely *ſpeculative*, it is then called *ſcience*; if it deſcend from ſpeculation to *practice*, it is called *art*; and if ſuch practice be converſant in regulating the *affections* and *paſſions*, it is then called *moral* virtue.

Before moral virtue can be attained, there are many appetites to be curbed, various propenſities to be corrected, and many temptations to be withſtood. When we reflect on the force of paſſion in thoſe who are in the habit of leading a ſenſual life, and the weakneſs of reſiſtance, the free agency of man may become a queſtionable ſubject. Miſerable indeed would be his condition, if the fatal neceſſity to obey the force of paſſion, to which the ſenſualiſt and the depraved is doomed, ex-

tended to the whole race; if he had not the power of confciousnefs itfelf, of directing and of regulating the ideas which in confequence arife, or if none could fubfift but what were excited by objects of fenfe.

It is well obferved, "* that if this were the "cafe, there could be no variety, and fcarcely "any change in the purfuits of men: the "thoughts muft flow from each other in one "uninterrupted feries, and man could not "be an accountable, and fcarcely a rational "being. It is, however, plain that we have "a power of interrupting the train of thought, "of dwelling more intenfely upon particular "ideas, and even of occafionally directing "our reflections and contemplations into new "channels; and this power alone is fufficient "to conftitute man a free agent †."

CHAP.

* Dr. Gregory on the Inconfiftency of the Fatalifts.

† It is very true that Mr. Locke has been falfely accufed of favouring the doctrine that all human actions were the refult of a fatal neceffity, which the individual could not prevent. This, however, is far from the truth. Mr. Locke fays, "This I think at leaft evident, that we find in ourfelves a POWER to begin or forbear, continue or end,

feveral

CHAP. XVII.

THE RELATION MAN BEARS TO THE DEITY.

Adam a free agent, and consequently the whole of the human race—brutes and savages, alone, under the influence of fatal necessity—the one religious, the other without religion —religion the base of morality, not morality the base of religion—both defined—the relation of man to the deity, and of the deity to man—the deity proclaimed.

THE first account we have of man was when the Almighty was proclaiming Adam a free agent. He was then told that punishment would be the consequence of disobedi-

several actions of our minds, or motions of our bodies; barely by a thought or preference of the mind ordering, or, as it were, commanding the doing or not doing such or such a particular action. The power which the mind has thus to order the consideration of any idea, or the forbearing to consider it, or to prefer the motion of any part of the body to its rest, and *vice versa*, in any particular instance, is what we call the will."—Locke's Essay, b. iv. c. 21.

 ence,

ence, and reward, of virtue. The power of acting was granted to him, but the manner how he was to act was particularly pointed out. Inftead of obeying the divine law, which marked out the conduct he was to purfue, he followed the fatal neceffity to which he was led by the force of fenfual inclination: it was the appetite in the organ of fenfe acting againft the power of the fpirit; the folly and wickednefs of man oppofing the wifdom and power of God.

This compound nature of man, we may prefume, was the caufe that led to the neceffity of marking out the proper mode of man's exiftence. The exiftence of that law before the commiffion of the deed, of the punifhment that was attached to the tranfgreffion of it, although it allows the free-agency of man, evidently contracts the uncontrouled freedom of his will. The condition of Adam in his time was the fame as our condition in our time. The conduct which man in civil fociety is to purfue is marked out, and defined by the exiftence of certain laws, which he muft not trefpafs. It is only in favage nations in general, or

or amongſt brutes in particular, that the uncontrouled freedom of will in man or in beaſt can be rightly aſſerted. Where no divine law has illuminated the beings by which thoſe countries are inhabited, and where no human law has ſubſiſted to harmonize the individuals into order, to reſtrain the violence of their paſſions, and bring them under proper ſubjection and controul; there indeed all is fatal neceſſity without free agency: it is the irrationality and violence of the brute without his inſtinct: all is freedom of will, and therefore all is confuſion; all order is inverted; the weak fall a prey to the ſtrong; women are the ſlaves of the men; the parents are devoured by their offspring; the offspring devoured by their parents; rapine is no crime where honeſty is no virtue; killing is no murder, where perſonal revenge is univerſally allowed; the ſexes although paired are not matched; and where promiſcuous and inceſtuous intercourſe prevails, neither adultery nor fornication has an exiſtence.

It has pleaſed God to confine a ſtate of things ſo miſerable and deformed to ſmall portions of men only, and amongſt the moſt ig-

norant and brutiſh of the whole race, until lately, when we have ſeen a great proportion of a great nation *caſting for a time* the fear of God from before their eyes, acting by virtue of the uncontrouled freedom of their wills, as if vomited out of the pandæmonium of hell to ſcourge and causticate mankind; the conſequences of which have been moſt admirably deſcribed by the late Mr. Burke, in a letter to * * * * * * †. It is impoſſible that ſo great a calamity

† Naturally men ſo formed and finiſhed are the firſt gift of Providence to the world; but when they have once thrown off the fear of God, which in all ages was too often the caſe, and the fear of man, which is now the caſe, and when in that ſtate they come to underſtand one another, and to act in corps, a more dreadful calamity cannot ariſe out of hell to ſcourge mankind. Nothing can be conceived more hard than the heart of a thorough-bred metaphyſician *; it comes nearer to the cold malignity of a wicked ſpirit, than to the frailty and paſſion of a man: it is like that of the principle of evil itſelf, incorporeal, pure, unmixed, dephlegmated and defæcated evil. It is no caſy operation to eradicate humanity from the human breaſt. What Shakeſpeare calls "the compunctious viſiting of nature" will ſometimes knock at their hearts, and proteſt againſt their murderous ſpeculations. But they have a mean of compounding with their nature: their humanity

* This is a miſnomer.

calamity could long fubfift; the difeafe was fo very malignant, that, unlefs corrected, it would have deftroyed and involved in its own vortex the whole humanity of the univerfe: we therefore find that a Supreme Being is now admitted to have an exiftence, and modes of worfhip publicly tolerated.

It is by this confeffion of humiliation, in which the very effence of religion confifts, by

manity is not diffolved, they only give it a long prorogation: they are ready to declare that they do not think 2000 years too long a period for the good that they purfue: it is remarkable that they never fee any way to their projected good, but by the road of fome evil: their imagination is not fatigued with the contemplation of human fufferings through the wild wafte of centuries added to centuries of mifery and defolation: their humanity is at their horizon; and, like the horizon, it always flies before them: the geometrician and the chemift bring the one from the dry bones of their diagrams, and the other from the foot of their furnaces; difpofitions that make them worfe than indifferent about thofe feelings and habitudes which are the fupport of the moral world. Ambition is come upon them fuddenly; they are intoxicated with it, and it has rendered them fearlefs of the danger which may from thence arife to others or to themfelves: thefe philofophers confider men in their experiments no more than they do mice in an air pump, or in a recipient of mephitic gas.

which man looks up to the Deity with devotion, and bows himſelf down with humility, as a being dependent and accountable; it is by the particular doctrines which particular religions enforce, that religion in general (that is, a Supreme Being admitted and believed by one inferior) is directed to particular modes of adoration and worſhip, and from whence the moral conduct of the individual takes its bend, whether that Deity be ſymbolized by the ſun or moon—by a ſtock or a ſtone.

It is the eſpecial object of the Chriſtian diſpenſation, to teach man to learn a knowledge of himſelf, that he may know what he really is—not fallible alone, but naturally born with corrupt affections, from the depravity of his animal nature, by which he is defiled, although poſſeſſing within himſelf a ſoul immortal and divine.

Religion ought therefore to conſtitute the baſe of every national eſtabliſhment, and be the rock which the whole nation ſhould graſp as one man: it ought to form the main-ſpring of his action; the beginning, the middle, and the end of his purſuits: it is then that all is peace and tranquillity within, whilſt war and ſtrife

ſtrife rage without; that the ſoul flouriſhes in immortal youth, unhurt amidſt the war of elements, the wreck of matter, and the cruſh of worlds. It is this that makes it triumph over indigence and oppreſſion, and riſe in full vigour when appetite is no more; that can ſmooth the brow of care, and diſpel the gloom of deſpondence, ſweeten the bitterneſs of grief, and lull agony to reſt.

Mankind, inſtead of making religion the baſis of morality, have lately got into the habit of making morality the ſum total of all religion: hence it was that Mr. Pope, who was a divine poet, but a bad divine, contended, that morality was the very baſe of all religion.

> " For modes of faith let graceleſs bigots fight,
> " His can't be wrong, whoſe Life is in the right."

So far from this poſition being true, it is totally falſe, and ought to be reverſed: the poetry muſt be made bad to have the divinity made good:

> " For modes of Life let graceleſs bigots fight,
> " He can't be right, whoſe Faith is in the wrong."

The truth of this poſition will evidently ap-

pear, if religion and morality are properly defined *. Religion, in the practical part, is a ſtudious conformity of our actions, our wills, and our appetites, to the revealed will of God, in pure regard to the divine authority, and to the relation in which we ſtand to God, as diſcovered to us by revelation: on the contrary, morality is a conformation of our actions to the relation in which we ſtand to each other in civil ſociety: ſo that although religion includes within its operation every branch of morality, morality falls very ſhort of attaining the duties of religion: it neither reaches the ſecret meditation of the mind, nor the ſilent deſires of the heart: it neither impoſes reſtraint upon the ſenſuality of the imagination, nor the private prurience of the appetite. Morality does not ſay, Thou ſhalt not covet, thou ſhalt love thine enemies, thou ſhalt bleſs them that curſe, do good to them that perſecute; neither does it enjoin the forgiveneſs of injuries, or the giving of alms to the poor: the higheſt principle in morals is a juſt regard only to the rights of each other in civil ſociety.

* See Biſhop Horſley's Charge to the Clergy of the Dioceſe of St. David's, and the Rev. Mr. Jones's excellent Treatiſe on the Catholic Doctrines of the Trinity.

The firſt principle in religion is the love of God; that is, a regard to the relation which we bear to him, as is made known to us by revelation. A religious man, ſtrictly ſo called, does good by deſign, and evil by chance: although his benevolence may be beſtowed on unworthy objects, the goodneſs of his motives abſolves him from any error they may cauſe: on the contrary, the mere moral man having no higher motives than perſonal gratification, the moral works he performs are conſequently irreligious, not contrary to religion, but without it: he therefore does good by chance; and if he commits evil, the ſelfiſhneſs of his motive precludes all charitable excuſe, becauſe he does it by deſign: it is therefore through faith in revelation, and which, in its beginning, is unqueſtionably a diſtinct gift of God, that we become religiouſly moral, have the fear of God conſtantly before our eyes, and conform our actions to the precepts of revelation. Faith conſtitutes the means—morality is the end. To ſuppoſe practice ſeparable from faith, is to ſay that the end is attainable without the means; or, finally, to affirm that faith can exiſt

exiſt without practice, is to ſuppoſe that a producing cauſe can exiſt without an effect. It is by the efficacy of this faith, that the diſtinction between the philoſopher and the ideot is aboliſhed, and by which "all that believe are ſaved"—by which all are ſaved, who believe "that the ſame God who ſpake in times paſt to the fathers by the prophets, hath, in theſe latter days, ſpoken unto us by his Son"—and "who believe him to be the effulgence of God's glory, the expreſs image of his perſon, the God whoſe throne is for ever and ever, the ſceptre of whoſe kingdom is a ſceptre of righteouſneſs."

"No limbs hath he, with human head adorn'd;
"Nor from his ſhoulders branch two ſprouting arms;
"To him belong nor feet, nor pliant knees;
"But MIND ALONE he was; ineffable
"And HOLY MIND; that rapidly pervades
"With providential care the mighty world *."

"O qui perpetua mundum ratione gubernas,
"Terrarum cœlique ſator, qui tempus ab ævo †
"Ire jubes, ſtabiliſque manens das cuncta moveri;
"Quem non externæ pepulerunt fingere cauſſæ
"Materiæ

* Harris's Tranſlation from the Greek of Empedocles.

† It is a matter of conſiderable difficulty to illuſtrate a ſubject

"Materiæ fluitantis opus, verum insita summi
"Forma boni, livore carens: tu cuncta superno
"Ducis ab exemplo: pulchrum pulcherrimus ipse
"Mundum mente gerens, similique imagine formans,
"Perfectasque jubens perfectum absolvere partes.
"Tu numeris elementa ligas, ut frigora flammis,
"Arida conveniant liquidis: ne purior ignis
"Evolet, aut mersas deducant pondera terras.
"Tu triplicis mediam naturæ cuncta moventem
"Connectens animam per consona membra resolvis.
"Quæ cum secta duos motum glomeravit in orbes,
"In semet reditura meat, mentemque profundam
"Circuit, & simili convertit imagine cælum.
"Tu caussis animas paribus, vitasque minores
"Provehis, & levibus sublimes curribus aptans
"In cælum, terramque seris: quas lege benigna
"Ad te conversas reduci facis igne reverti.
"Da, pater, augustam menti conscendere sedem,
"Da fontem lustrare boni, da luce reperta
"In te conspicuos animi defigere visus.
"Disjice terrenæ nebulas & pondera molis,
"Atque tuo splendore mica: tu namque serenum,
"Tu requies tranquilla piis: te cernere, finis.
"Principium, vector, dux, semita, terminus idem."

Boethius, a Roman Senator and Christian Platonist, was barbarously put to death by Theodoric, King of the Goths, under the pretext of acting treasonably; but in reality because he was a Trinitarian.

"Celui

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subject so abstract and abstruse as this of eternity and time unquestionably is, by any figurative imagery. The following

"Celui qui met un frein à la fureur des flots,
"Sçait auſſi des méchans arrêter les complots.
"L'Eternel eſt ſon nom : le Monde eſt ſon ouvrage:
"Il entend les ſoupirs du pauvre qu'on outrage.
"Il juge les Mortels par des égales loix,
"Et du haut de ſon trône interroge les Rois.
"Que peuvent contre lui tous les Grands de la terre?
"En vain ils s'uniroient pour vaincre ſon tonnerre ;
"Pour diſſiper la foule, il n'a qu'à ſe montrer—
"Il parle—& dans la poudre il les fait tous rentrer."

Racine.

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ing appear to be the moſt obvious : let us ſuppoſe for example, that the univerſe is a ſphere, and that an eye is fixed in the centre of it, whoſe viſive power can behold at once the whole motion of all the bodies within the ſphere, *not thoſe of the moment only*, but thoſe that *ever have been or ever will be*, ſuch an extended and infinite perception would repreſent not a *temporal* but an *eternal* energy.

On the contrary, if an eye were placed in the ſame ſituation as the former ; but inſtead of ſeeing all the motions at once, that ever have been from the beginning to the end of time, ſhould ſee them in *ſucceſſion one after another as we do* ; this will illuſtrate the nature, perhaps imperfectly, of what *a temporal energy* actually is; and by comparing the one with the other, we ſhall ſee the diſtinction that ſubſiſts between an eternal and indiviſible perception, between a diviſible and temporal one.

Time and eternity are two meaſures, the former of corporeal things, the latter of intellectual beings : the one has its ſubſiſtence in becoming to be, or in paſſing into exiſtence, and therefore never truly *is* ; hence it is perpetually flowing, and cauſes every thing with which it is connected

connected to be tranſient and frail : on the contrary, eternity is a total ſubſiſtence, or poſſeſſes every thing collected in an indiviſible one, or, as Cowley ſays, "AN EVER ABIDING NOW:" it may therefore be called infinite, at once total and full, which has no connection with the paſt and the future, but comprehends in itſelf all the diviſion of time, namely, the paſt, preſent and future, according to cauſal tranſcendency.

In the year 1784, Mr. Charles Wilkins tranſlated at Benares an ancient Hindoo poem, called the Bhaguat-Geeta, ſuppoſed to have been near five thouſand years old, in which the Incarnation of the Deity is evidently proclaimed; and moſt of the other principal tenets of the Chriſtian religion. This very curious work is now very ſcarce; but Mr. Morrice in his Indian Antiquities, a work of great labour and ability, has given very copious extracts from it, with illuſtrations, for the benefit of thoſe who have not the advantages of a Chriſtian education, or attained any knowledge of the Platonic philoſophy, from which ſource it is probable that it is originally derived. The reſemblance that ſubſiſts between the Platonic doctrine and the Chriſtian, Dr. Horſley obſerves, "may ſeem a wonderful fact, which may juſtly draw the attention of the ſerious and inquiſitive: and if it ſhould be deemed incredible, as well it may, that Reaſon, in her utmoſt ſtrength, ſhould ever aſcend ſo high, as to attain even to a diſtant glimpſe of truths, which have ever been reckoned the moſt myſterious diſcoveries of Revelation; it will become a queſtion of the higheſt importance to determine by what means the Platonic ſchool came by thoſe notions of the Godhead, which, had they been of later date

date than the commencement of Chriſtianity, might have paſſed for a very mild corruption of the Chriſtian Faith, but, being in truth much older, have all the appearance of a near, though very imperfect view of the doctrine which was afterwards current in the Chriſtian church. This learned Prelate proceeds to ſay, "that the enquiry becomes more important when it is diſcovered, that theſe notions were by no means peculiar to the Platonic ſchool; that the Platoniſts pretended to be no more than the expoſitors of a more ancient doctrine, which is traced from Plato to Parmenides; from Parmenides to his maſter of the Pythagorean ſect; from the Pythagoreans to Orpheus, the earlieſt of the Grecian myſtagogues; from Orpheus to the ſecret lore of the Egyptian prieſts, in which the foundation of the Orphic theology was laid. Similar notions of a triple principle prevailed in the Perſian and Chaldæan theology, and veſtiges even of the worſhip of a Trinity were diſcernible in the Roman ſuperſtition in a very late age. This worſhip the Romans had received from their Trojan anceſtors, for the Trojans brought it with them into Italy from Phrygia; in Phrygia it was introduced by Dardanus, ſo early as in the ninth century after Noah's flood. Dardanus carried it with him from Samothrace; where the perſonages that were the objects of it were worſhipped under the Hebrew name of Cabirim. Who theſe Cabirims might be, has been a matter of unſucceſsful enquiry to many learned men: the utmoſt that is known with certainty is, that they were originally three, and were called by way of eminence, the Great or Mighty Ones; for that is the import of the Hebrew name. And of the like import is their Latin appellation, *Penates*, Dii per quos penitus ſpiramus, per quos

quos habemus corpus, per quos rationem animi poſſidemus. Dii qui ſunt intrinſecus atque in intimis penetralibus cæli. Thus the joint worſhip of Jupiter, Juno, and Minerva, the triad of the Roman Capitol, is traced to that of the THREE MIGHTY ONES in Samothrace, which was eſtabliſhed in that iſland, at what preciſe time it is impoſſible to determine, but earlier, if Euſebius may be credited, than the days of Abraham.

The notion therefore of a Trinity, more or leſs removed from the purity of the Chriſtian faith, is found to have been a leading principle in all the ancient ſchools of philoſophy, and is the religion of almoſt all nations. *Vide Tracts by Dr. now Biſhop Horſley*, p. 44.

CHAP. XVIII.

THE RELATION OF DEITY TO MAN.

Deity known by ſoul alone—the true energy of ſoul, contemplation and abſtraction—the ſenſualiſt, therefore, not a religious being—much leſs brutes and vegetables—the cauſe why—energy natural to the rational, ſleep to the vegetable life—the immateriality of the ſoul proved.

WHEN this tranſcendent and omnipotent Being is contemplated, "through this opaque of nature and of ſoul," it is then time for all to exclaim in the words of the immortal Young:

"How poor, how rich, how abject, how auguſt,
"How complicate, how wonderful is Man!
"How paſſing wonder He, who made him ſuch!
"Who centred in our make ſuch ſtrange extremes!
"From different natures marvellouſly mixt,
"*Connexion* exquiſite of diſtant worlds!
"Diſtinguiſh'd *link* in being's endleſs chain!
"*Midway* from *Nothing* to the Deity!
"A beam ethereal, ſullied and abſorpt!
"Though ſullied and diſhonour'd, ſtill divine!
"Dim Miniature of Greatneſs abſolute!
"An Heir of Glory! a frail Child of Duſt!
"Helpleſs Immortal! Inſect infinite!
"A Worm! a God!"

It

It is by that godlike power we contain, which has been reprefented to be an image of God himfelf, and therefore confidered as eternal and divine, by which he can be contemplated and approached. Nothing lefs than a pure immaterial power could in any degree be fufceptible of the contemplation of fuch a BEING, more perfectly when it abftracts itfelf from objects of fenfe, than when it exerts its energy upon fenfible objects through the medium of organs of fenfe. Hence it would feem arofe that important axiom, *Quidquid recipitur, recipitur in modum recipientis;* that is to fay, organs of fenfe are alone qualified to receive impreffions from *fenfible* objects; whilft, on the contrary, Soul, by virtue of its immaterial and immortal power, can alone receive the influence of *a divine and contemplative nature.* It is by the exercife of this power, exerted on its proper objects, that man feels himfelf confcious that he forms the firft clafs of all generated beings.

Between the pure energy of Soul, the refult of wifdom by abftraction from animal life, and the higheft degree of inftinct, the offspring of brutal exiftence, the chafm is

 too

too great for the one to communicate knowledge which the other can receive or comprehend. Man, therefore, in the adoration he pays to the Deity, muft elevate and feparate himfelf from his animal nature; and on the contrary, in his intercourfe with the lower order of beings, he muft debafe himfelf to the level of the brute, or the brute muft be elevated to the level of the man, for the one to underftand the other. The moft rational man is as unable to impart his meaning to the moft irrational animal, as the moft irrational animal is unable to receive the fentiments of the moft rational man. The caufe lies in the excellence of man, and in the irrationality of the brute: the moft fagacious animal is more tractable than the moft imbecil, more tractable to the man who debafes his underftanding by accommodating it to the comprehenfion of the brute—than of the philofopher who is replete with wifdom and knowledge:—it is with a view to adapt our meaning to the nature of the underftanding of the beaft by which that meaning is to be received, that, in our intercourfe with animals, we converfe with them in a filly unmeaning manner; because

caufe a wife and fignificant converfation would be unintelligible to them. Children, therefore, or men who act like children, are moft noticed by animals, and have them more immediately under their controul. We may from hence learn why the fenfualift is not, and cannot be, a religious being, and why brutes in general cannot have any idea of the deity. Much lefs is it poffible for vegetables—of thofe beings that feem deftitute of confcioufnefs, and almoft of every fentient principle *.

"Say, why was Man fo eminently raifed
"Amid the vaft creation; why empowered
"Thro' Life and Death to dart his watchful eye,
"With thoughts beyond the limits of his frame;
"But that th' Omnipotent might fend him forth,
"In fight of Angels and immortal Minds,
"As on an ample theatre, to join
"In conteft with his equals, who fhall beft
"The tafk achieve, the courfe of noble toils

* Various attempts have been made to draw analogies between vegetables and the lower order of animals. The analogy applies when it is confined to the vital power of both; but it totally fails when attempts are made to extend it either to the principles of fenfation, or more efpecially to that of confcioufnefs.

" By wisdom or by mercy pre-ordained * ;—
" Might send him forth the sovran good to learn ;
" To chase each meaner purpose from the breast ;
" And through the mists of Passion and of Sense,
" And through the pelting storms of Chance and Pain,
" To hold straight on, with constant heart and eye
" Still fix'd upon his everlasting palm,
" The approving smile of Heaven ?"

Akenside's Pleasures of Imagination, b. i.

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* No doctrine has ever perhaps been more completely mistaken than that of *prædestination.* By many it has been thought, that some there were who were elected and prædestined to enjoy every blessing in this life and happiness in the next, notwithstanding the wickedness of their conduct ; others again that were doomed to suffer every misfortune in this state of existence, and to endure eternal damnation hereafter, however meritorious their conduct might have been.

If this explanation were true, instead of the Almighty being what he is, all-bounteous, wise and just, and the source of all goodness, it might rather be supposed that he is the very Devil himself, and the cause of all evil. Great indeed is the error of those who judge in this way. It is very true that in the general scheme of Providence, Prædestination is a doctrine especially foretold by Revelation that shall be the lot of the elect : but the elect grossly deceive themselves, if any suppose themselves præ-elected : the only way that they can make their election sure is by religion, and the duties which it enforces. It is not therefore *particular men that are elected*—but *men of a particular description*—which description the Gospel has specified.

Of

Of Sleep.

It is by the energy of this intellective power, which man possesses in a degree infinitely superior to all other animals, by which he is especially distinguished; but it is the energy of this power also which has a constant tendency to weaken the power of the living principle, and a suspension made necessary, either of mental energy, of voluntary action, or of both; and from whence sleep becomes so salutary to the animal frame.

Sleep is that condition of the system when the sentient and rational principles have a total suspension of action, when external impressions are of none effect, and the mind itself is in a dormant state; the living principle therefore has a total increase of energy, the actions that contribute to health and strength of body are in full vigour, because the actions of mind that produce weakness and disease are in a passive state; namely, those of consciousness, of sense, and of voluntary motion.

Such is the natural condition of the fœtal state, that the various substances are absent upon which the organs of sense and of sensa-

tion are deftined to act; and the organs themfelves are not properly evolved. Sleep, therefore, muft be its natural condition. In infancy, when the various fubftances are immediately applied to the different organs of fenfe, and their dormant power is excited into energy and action, the calls of hunger being prefent, the dormant powers of the voluntary organs are excited, a beginning of fpecific action is produced, and fleep fuftains frequent remiffion: but as the evolution of the rational principle increafes by the perfection of the different organs fubfervient to its ufe, the energy of the living principle decreafes, and is only exerted in preferving the parts that it has evolved. Sleep then becomes lefs frequent, and even conditional—dependent on the degree of mental energy and of voluntary motion: and if we could behold the perfection of human exiftence at the periods of manhood, and efpecially of old age, when the mind has been in conftant habits of meditation and of abftraction, fleep would be almoft foreign to the nature of man; but, alas! man in this life has not attained this bleffed ftate.

If man were totally a rational being, conftant

ſtant watchfulneſs would be his natural condition, becauſe action without remiſſion is the eſſential and immediate attribute of Mind; and if he were totally an irrational being, he would be obliged to follow the laws of inſtinct, with its particular directions; the adult would be like the fœtal ſtate; the rational like the torpid; both would reſemble vegetable life: ſleep would be inſeparable from the exiſtence of man, and would conſtitute his natural ſtate.

Neither of theſe extremes is the true condition of human exiſtence, but a medium between both: the rational principle in man is united to a corporeal frame, through the medium of the living principle: it is by the conſtant and continued energy of this living principle on external cauſes, that the corporeal ſyſtem is developed and preſerved, and the organs of ſenſation and of volition are unfolded and perfected; but it is owing to the internal energy of the mind that theſe organs are made to act according to its decrees.

Animals poſſeſs not only the intellective power, but the ſenſitive and the vegetative alſo; the

the lower order poſſeſs the ſenſitive and the vegetative; and vegetables poſſeſs the living or vegetative alone: it is owing to this privation of all ſenſitive and conſcious powers that a ſtate of ſleep is the natural condition of vegetable life; and although it is true that the corolla do occaſionally betray ſome ſigns of voluntary power, we find it always produces a diminution of growth; becauſe it is a fact, that vegetables grow much faſter in the night than in the day.

Great and ſublime, however, is the knowledge of thoſe who admit the exiſtence of one ſingle Immaterial Principle as the cauſe of all animated exiſtence, and of the various actions they perform, although they deny the ſeparate ſubſiſtence of an immaterial ſoul, when that knowledge is compared to the dire ignorance of a ſet of pretended philoſophers, calling themſelves Materialiſts, who ignorantly and arrogantly deny the exiſtence of any immaterial principle whatever, and who falſely aſſert, that the whole of creation, both animated and dead, both active and paſſive, is conſtituted of matter, and that the only difference

ference between them, depends on the mechanical arrangement of the parts in which the proximate cause of Life and of Mind essentially resides.

Those who suppose that mind or soul is an effect of which organization is the cause, virtually adopt the Brunonian doctrine, which makes Excitement the cause, of which Life is the effect. The arguments, therefore, which I employed to prove that Excitement was not the cause of Life, equally apply to show that the brain is not the essential cause of soul, although it is the instrument through which its energy is displayed.

It must evidently appear that these gentlemen begin where they ought to end: they attribute inertness to matter, and yet make it the cause of action; they behold it destitute of form and of inherent power, and yet refer organization to its weakness; in every case they see it matter impelled, and yet they make it impelling matter; it is ever the last and the worst of things, and yet they make it to be the first and the best; they always begin with effects, and never end with cause; they constantly confound cause and effect, instead of separating

ſeparating them; they miſtake the thing produced for the power producing, and the fact for the law. Inſtead, therefore, of putting confuſion in order, they put order in confuſion: it is owing to this perverſion of all ſcience, to this total inverſion of all principles, that new theories do annually ariſe for the explanation of the ſelf-ſame phænomena.

Upon a matter of ſo much importance I ſhall think it right to avail myſelf of the unanſwerable arguments which the late Dr. Samuel Clarke employed againſt Mr. Dodwell the materialiſt, to prove that the ſoul is neither a quality inherent in matter, nor the reſult of the arrangement of its parts: it was his book that lightened my darkneſs, blinded as it was to the degree of ſuppoſing that the attributes of matter were the cauſe of every thought and action, of every effort of conſciouſneſs and of abſtraction.

That the ſoul cannot poſſibly be material, is demonſtrable from the ſingle conſideration of bare ſenſe or conſciouſneſs itſelf; for, matter being a diviſible ſubſtance, conſiſting always of ſeparable, nay, of actually ſeparate and diſtinct parts, it is plain, that, unleſs it

were

were eſſentially conſcious, in which caſe every particle of matter muſt conſiſt of innumerable ſeparate and diſtinct conſciouſneſſes, no ſyſtem of it, in any poſſible compoſition or diviſion, can be one individual conſcious being.

For, ſuppoſe three or three hundred particles of matter, at a mile or any given diſtance one from another, is it poſſible that all theſe ſeparate parts ſhould, in that ſtate, be one individual conſcious being? Suppoſe then all theſe particles brought together into one ſyſtem, ſo as to touch one another, will they thereby, or by any motion or compoſition whatſoever, become one whit leſs truly diſtinct beings than they were when at the greateſt diſtance? How then can their being diſpoſed in any poſſible ſyſtem make them one individual conſcious being? If you would ſuppoſe God, by his infinite power, ſuperadding conſciouſneſs to the united particles, yet ſtill theſe particles, being really and truly as diſtinct beings as ever, cannot be *themſelves* the *ſubject* in which that individual conſciouſneſs *inheres*, but the conſciouſneſs can only be ſuperadded by the addition of ſomething, which in all the particles muſt ſtill itſelf be but one individual being.

The

The Soul, therefore, whofe power of thinking is undeniably ONE individual confcioufnefs, cannot poffibly be a material fubftance.

If however it be fuppofed, that the Soul is a material fubftance, and that the brain, or any other part whatever, is the organ where it refides, it muft evidently follow, that the quality of this organ muft be made up of the individual qualities of all its parts: for example, the bulk of a body is made up of the fum of the magnitude of all its parts; its motion is nothing but the fum of the motion of all its parts; and if thinking or confcioufnefs can be fuppofed to be a quality inherent in a fyftem of matter, it muft be alfo the fum and refult of the thinking and cogitation of all its feparate parts. We fhould therefore have as many diftinct confcioufneffes or minds as there are particles of matter of which the brain confifts: an idea fanciful and falfe; for compofition or divifion of magnitude varied in infinite manner to eternity, can produce nothing in the whole fyftem but magnitude; compofition or variation of motion, nothing but motion; compofition and variation of figure, nothing but figure: and fo of every other quality whatever.

If however it be ſuppoſed that not the brain altogether, but one particle of it alone, is the ſeat of the Soul, &c. &c. *That one* particle being diviſible into two, there muſt neceſſarily be two diſtinct Souls, not one Soul, and each muſt think apart, and not together.

And finally, it is impoſſible, that either the brain or nerves, or any other part of the body whatever, from the crown of the head to the ſole of the foot, can inherently poſſeſs mind with its attributes, and eſpecially that of memory; for, as every part is conſtantly flowing and periſhing, if the attributes of mind depended on matter and organization, it is impoſſible that any permanent ideas of things could exiſt; for they can never ſurvive the duration of the organ, or of the part by which thoſe ideas were received: for, as new particles are depoſited as the old are abſorbed and carried away; it evidently follows, that we could poſſeſs only half an idea of any one ſubject, and that for a ſhort time alone. Memory, I ſay, could form therefore no part of ſuch a ſyſtem; for, as no effect can ſurvive its cauſe, and as the organ is the cauſe in which conſciouſneſs or mind is ſuppoſed on that hypotheſis to reſide, the

the recollection of paſt events can never extend the limits of ſeven years at fartheſt; becauſe we find from experiments apparently ſatisfactory, that, in that period, the whole of the ſyſtem has undergone a complete and total renovation and change; ſo that when the organization of the ſyſtem is decayed and deſtroyed, a complete annihilation would enſue of the various powers by which the ſyſtem performed its functions—ſimilar to a clock, or to any other machine *.

* It is an obſervation made by Mr. Jefferſon, in his Notes on Virginia, " that the exiſtence of the Negro ſlaves in America appears to participate more of ſenſation than of reflection: to this muſt be aſcribed their diſpoſition to ſleep, when abſtracted from their diverſions, and unemployed in their labour. An animal, whoſe body is at reſt, who does not reflect, muſt be diſpoſed to ſleep of courſe." p. 255.

The time, however, I hope, is faſt approaching, when the Negro will hold the rank he ought in the great chain of human exiſtence; when he will participate more of reflection than of ſenſation; more of watchfulneſs than of ſleep; more of civil than of ſavage life.

PART

PART II.

CHAP. I.

OF THE ANATOMICAL STRUCTURE OF THE VEGETABLE SYSTEM, BY MEANS OF WHICH IT FULFILS THE FINAL CAUSE OF ITS EXISTENCE.

Of the radicles, root, ſtem, &c.—epidermis—cortex—l'enveloppe cellulaire—liber—alburnum—lignum—medulla—fructification—efflorescence, &c. &c. &c.

A Vegetable Syſtem, like every other, is compoſed of various parts, which are deſigned for different purpoſes. The baſe on which it ſtands, and by which it is attached to the ſoil, is conſtituted of radiculæ or radicles, which terminate in a caudex or root: the portion which ariſes immediately from the root, and which is generally ſituated above the ſurface

face of the ground, conſtitutes the trunk or ſtem: from this ſtem there proceed various ramifications, which give birth to the foliage, to the fructification, and efflorefcence.

The living power, by which theſe various parts are at firſt evolved and ultimately perfected, reſides within: the ſubſtance upon which this power acts, ſubſiſts from without; the organs which poſſeſs theſe powers are called digeſtive or aſſimilating organs; and the ſubject matter on which they act is called food, or nutritious matter.

Every part of a plant is externally protected by a ſubſtance called EPIDERMIS, varying in point of ſolidity and duration in different ſyſtems: in ſome it is thin and tranſparent; in others it is more ſolid and opake; in all it is fibrous, and ſufficiently porous to admit the tranſmiſſion of moiſture. Immediately beneath the epidermis there is a ſubſtance which Du Hamel called *l'envelope cellulaire*, which is thought to be analogous to the rete mucoſum of animals: it conſtitutes in an eſpecial degree the cauſe of the variety we behold in the colour of different plants: it forms

forms the connecting medium between the epidermis and the cortex or outer bark.

The Cortex.

Immediately beneath this cellular fubftance the cortex or outer bark is fituated: it is of a more folid nature than the epidermis; it extends over the whole furface of the vegetable, from the radicle to the terminated extremity of the branches: if it be removed partially, the plant withers and decays: if it be ftripped off altogether, the plant decays and dies. It would feem, that it is this particular part which conftitutes the true digeftive organ of the vegetable, or vegetable ftomach: the digeftive power of this fubftance is ftronger and weaker in different parts of its courfe: it appears to be more perfect in the radicles than in the roots, in the roots than in the trunk, and in the trunk than in the branches *.

Under

* Linnæus erroneoufly imagined, that vegetables digefted nothing, but only extracted chyle from the moift earth, by means of their roots, which he fuppofed to be analogous to the lacteal veffels of animals. It is falfe that this chyle exifted in the moift earth before it was

 digefted.

Under the cortex the LIBER is ſituated: it is inveſted by the cortex in the ſame manner as the cortex itſelf is inveſted by the epidermis: it is generally of a green colour, of a

digeſted: the moiſture exiſted in the earth only, and was the medium through which it was conveyed and received; it was the digeſtive power of the plant itſelf, alone, that converted this moiſture into living vegetable matter, out of which the medulla of the plant is formed. Neither is it true, that the lacteal veſſels of animals are analogous to the roots of vegetables. The lacteal veſſels of animals only receive food that had already been changed by the organs of maſtication, and aſſimilated by the digeſtive power of the ſtomach; the organs of maſtication prepare the food in point of quantity for the organs of deglutition to convey. The organs of deglutition, by which the maſticated food is received, convey it to the organ of digeſtion where it is changed; it is then that the quality of external ſubſtances is totally changed and converted, and when it is fitted and prepared for the lacteal veſſels to abſorb.

On the contrary, the roots of vegetables effect a total change upon the ſubſtances they receive. It is this aſſimilated matter, which is at once aſſimilated by the cortical part, which conſtitutes the medulla of the plant, and which is conveyed throughout the whole extent of the vegetable ſyſtem; it is the medulla which conſtitutes the ſubject matter upon which the living principle of the vegetable acts, and out of which the various parts are evolved, and the different ſpecies of fructification produced.

flexible

flexible and laminated ſtructure *, which may be rendered very apparent by maceration in water.

Immediately beneath the liber there generally reſides a ſubſtance of a white colour, and rather ſoft in its texture, called ALBURNUM: it is harder in vigorous trees than in ſuch as are weak; and ſofter in annual than in perennial plants: it ſeems to conſtitute a medium between the bark above and the wood beneath: it probably conſiſts of the matter which the cortex and liber had aſſimilated and converted, and which is there prepared for the lignum or wood to abſorb.

The Lignum or Wood

Is ſituated immediately under the alburnum: it conſtitutes the principal bulk of a tree; it forms the matrix for the paſſage of the different veſſels of which the plant is compoſed; the layers are generally concentric to each other, one of which is added every year: the cloſeneſs of theſe layers varies in different

* It has obtained the name of *liber* in conſequence of being the ſubſtance which the ancients uſed to employ to write on as we do paper: it is even ſuppoſed that China paper is the liber of ſome particular tree.

 trees,

trees, and in the ſame tree when ſubſiſting in different countries. In warm countries, where vegetation is rapid, theſe layers are not ſo compact as in cold, where vegetation is more languid and ſlow; the layers that face the north are even denſer than thoſe that receive a more abundant ſupply of heat from the ſolar rays. As it ſeems probable, that there is one of theſe circular layers of the lignum annually depoſited, Botaniſts can conſequently aſcertain the age of a tree: in one oak which Linnæus examined, he reckoned 300 of them.

The Medulla or Pith

Is ſituated in the centre of the tree: the outer edge of the pith is generally ſurrounded by a ring of woody fibres; and which it has been ſuppoſed conſtitute the true ſap veſſels: it is from thence depoſited in the various cancelli, which contain the parenchyma or pith.

The medulla is produced in greater abundance in young than in old trees, in the ſpring and ſummer than in the autumn and winter; at their periods of vegetation and of growth, than in their caducous or torpid ſtate. It is of a white colour, and varies in point of conſiſtency

fiftency in different fyftems, and in different ages of the fame fyftem *.

The Nature of the Medulla.

It bears the fame relation to the vegetable fyftem in which it is contained, as the blood of animals does to the animal fyftem: it conftitutes the fubject matter out of which the whole vegetable fyftem is evolved, and from whence the various fecreted fluids are produced. Such is the perfection of the vegetable œconomy, that the cortical part of the plant poffeffes the power of forming medulla, with-

* Linnæus was of opinion that the lignum was depofited from the medulla: on the contrary, Duhamel and Dr. Hope proved by experiment, that it was a depofition either from the liber itfelf, or from the matter which the liber had received and affimilated. Duhamel made a longitudinal incifion through the bark which covered the trunk of a cherry tree. After having raifed it, and carefully excluded the admiffion of air, he inferted a thin plate of tin foil: a few years after he examined the appearance of the part by cutting through the bark, and found the tin foil wholly and completely embodied and covered by the wood. Dr. Hope's experiment before related, whilft it proves the affimilating power of the liber, fhews alfo that it is the fource from whence the lignum is formed and depofited.

out the intervention of the different chylopoetic organs ſo neceſſary to the higher order of animals *.

It is formed immediately by the moſt ſimple means poſſible; not by the roots only, but by the whole cortical part of the trunk and branches. The medulla of the ſtump is principally produced from the roots; although the cortical part of the ſtump and branches poſſeſſes theſe aſſimilating powers alſo. This fact is abundantly proved in thoſe caſes which we often behold, where there is a ſolution of continuity between the medulla of the roots and ſtump, and the medulla of the extreme branches. It is wonderful to behold the immenſe vegetation that frequently enſues from *apparently* a very inadequate power in the plant, a degree of power which obviouſly ſurpaſſes that of any animal whatever.

* It is owing to the imperfection of their frame that digeſtion is a preliminary ſtep to chylification. Digeſtion is the cauſe of which chylification is the effect; and finally, chylification is the mean, and ſanguification is the end: they therefore require organs of maſtication and of digeſtion, of chylification and reſpiration, before ſanguification can be produced.

Of

Of the Motion of the Medulla or Sap.

Thoſe who have wiſhed to force an analogy between vegetables and animals, have endeavoured to prove that the different functions of both were performed by one and the ſame mean; and that the ſap of vegetables was in a ſtate of conſtant circulation like the blood of animals. Such an opinion as this is neither warranted by the diſcovery of any organ by which this circulation can be produced, or by any obſervation from whence this opinion can be ſupported; it can only ariſe from a total ignorance of the difference that ſubſiſts between them. Vegetables are not only deſtitute of a heart, but of lungs alſo.

That the food from which the medulla is formed aſcends, is proved by facts obvious and ſtriking. If plants are placed in water tinctured with a colouring matter, the whole of the plant will participate of the die, as perfectly as animals that are fed on madder: and finally, when leaves are flaccid and exhauſted from penury of water, if the plant be properly ſupplied, the flaccidity departs, and they become erect and rigid. Although the aſcent

of

of the ſap is proved beyond all doubt, Dr. Hales, in his Vegetable Statics, has aſcertained, in a manner equally ſatisfactory, that it does not circulate. There is a fact mentioned by Monſieur Muttel which decides the point. On the 12th of January he placed ſeveral ſhrubs in pots againſt the windows of his hot-houſe, ſome within the houſe, and others without it: through holes made for this purpoſe in the panes of glaſs, he paſſed a branch of each of the ſhrubs, ſo that thoſe on the inſide had a branch without, and thoſe on the outſide had a branch within: after this, he took care that the holes ſhould be exactly cloſed and luted: the 20th of January, a week after this diſpoſition, all the branches that were within the hot-houſe began to diſcloſe their buds; in the beginning of February there appeared leaves; at the end of it, ſhoots of a conſiderable length which preſented young flowers. A dwarf apple-tree, and ſeveral roſe-trees, being ſubmitted to the ſame experiment, ſhewed the ſame appearance then, as they commonly put on in May: in ſhort, all the branches which were within the hot-houſe, and conſequently kept in warm air, were grown at the

the end of February, and had their ſhoots in great forwardneſs. Very different were thoſe parts of the ſame tree which were without, and expoſed to the cold: none of theſe gave the leaſt ſigns of vegetation; ſo that ſome of the branches of the ſame tree that were putting forth ſhoots, leaves, and buds, had other branches in a torpid, and even in a frozen, and in a dead ſtate.

Such is the high degree of living power which vegetables poſſeſs, that the different parts of which they are compoſed do not undergo, in the progreſs of their evolution, the ſame mutation and decay which the moſt complicated animals ſuſtain: the medulla is therefore propelled by the power of the veſſels in which it is contained, in a regular and progreſſive aſcent to ſupply the ſyſtem with nouriſhment and ſupport.

With animals, and eſpecially thoſe of the higher claſs, it is far otherwiſe: ſuch is the conſtant deterioration which the parts undergo, that an abſolute neceſſity does exiſt, that freſh materials ſhould be conſtantly ſupplied: hence ariſes the neceſſity, not of mere progreſſion in the blood, but of a conſtant

ſtant progreſſion and circulation alſo; not only that the blood itſelf might be meliorated and depurated from the waſte it has ſuſtained by the action of a particular organ (the lungs) to which this office is eſpecially deſigned; but that the whole of the ſyſtem itſelf might be more abundantly ſupplied with blood.

It is by the action of the lungs that the blood is meliorated, but it is by the action of the vaſcular ſyſtem that it is conveyed.

The magnitude of theſe organs of purification and of motion bears a proper ratio to the degree of waſte which the ſyſtem undergoes, and which may be known by attending to the claſs to which each reſpectively belongs.

The human ſpecies, and quadrupeds in general, have large lungs, with ſmall cells. The amphibia have comparatively ſmall lungs, with large cells, and fiſh have gills only; ſo that, in proportion as we deſcend in the great chain of animated exiſtence, we find a diminution in the extent, and conſequently in the power, of this organ.

Connected with this variety that ſubſiſts in the power of this purifying organ, we find a correſpondent difference in the organ alſo by which

which the blood is conveyed. In man and quadrupeds, the heart is compoſed of four cavities; in the amphibia, of three; in fiſh, of two; and in moſt of the inſect tribe, the vaſcular power by which the blood is propelled, conſiſts of *one* ſingle veſſel only, reſembling in an eſpecial manner the mode by which the medulla of the vegetable ſyſtem is conveyed. In many plants, the medullary matter gradually forſakes the roots, which it leaves hollow—in all, it is the ſubject matter out of which the fructification, the effloreſcence, the foliage, and the ſecreted fluids are formed and produced.

Of the Fructification.

The fructification of a plant conſiſts of ſemina or ſeeds: they are inveſted and protected by the pericarpium: the pericarpium is diſtinguiſhed by different appellations, according to the difference in the peculiarity of its ſtructure *: although it generally forms a part of the

* As 1. Capſula or caſket. 2. Siliqua or pod. 3. Lignum or pulſe. 4. Folliculus, or little bag. 5. Drupa: this is a fleſhy pericarpium, in which is contained a nut or

the ovum, in fome inftances it is found deficient.

Of the Efflorefcence in general, and Female Organs in particular.

There arifes, either directly from the fummit, or from the fides of the germen or feedbud, an erect column, called piftillum, the bafe of which has received the appellation of ftyle, and which is terminated by the ftigma or crown of the piftil; it is generally found with a downy covering of a moift quality. It is this organ which Linnæus fuppofes conftitutes the female parts of generation.

or kernel, that is, a feed inclofed within a hard ligneous cruft, as in nuts, olives, peaches, plums, almonds, &c. 6. Pomum or apple, which is a flefhy or pulpy kind of pericarpium: it contains in the middle a membranous capfule with feveral cells, in which the feeds refide. 7. Bacca or berry, which is a flefhy pericarpium alfo: it inclofes one or more feeds, imbedded in pulp, as in folanum. 8. Strobilus or cone: this is a pericarpium, formed from the calices of the amentum, which itfelf is a fpecies of calyx, confifting of feveral fcales, united to an oblong receptacle.

The pericarpium would feem to be the germen perfectly evolved, and the immediate recipient for the feeds; it is fituated at the very centre of the flower.

Of

Of the Stamina, or Male Organs.

External to the piftil juft defcribed, we find the ftamina to be fituated: they vary in number in different plants, and were fuppofed by Linnæus to conftitute the true male organs of generation; it is upon the number of thefe parts, and in the mode of their pofition, that the fexual fyftem is founded. The *ftamen* is generally divided into two parts, and each part called by a particular name. The bafe immediately arifes from the plant, and appears to germinate from the wood; it proceeds in a threadlike form, called *filamentum*, which is terminated by the *anthera*: the anthera generally confifts of two cavities, which ultimately burft, and difcharge a fine farinaceous fubftance called *pollen*: this pollen it is which is fuppofed to be analogous to the male femen, and is therefore called *farina fæcundans*, or impregnating duft, and is efpecially deftined to impregnate the germen.

External in point of fituation to the ftamina, the corollæ or painted leaves are fituate: they feem to arife from the liber, as the ftamina themfelves did from the lignum: they are united

united to the liber by a petal, the ſummit of which is called nectarium or honey-cup; it is from the ſurface of theſe parts that a quantity of ſaccharine matter is ſecreted, and which affords ſuch abundant nouriſhment to bees, &c.

The efflorеſcence, which contains the different parts I have above deſcribed, either totally or partially, are called by different names: thoſe that have ſtamina and piſtilla are called hermaphrodite or perfect flowers, having both ſexes united together in one ſubject: thoſe that have piſtilla without ſtamina are called females: thoſe with ſtamina but deprived of piſtilla are called males: and when both ſexes exiſt diſtinctly upon the ſame tree, as in the claſs of monœcia, theſe are called androgynous; and, finally, the whole of the fructification and of the effloreſcence is bounded and incloſed by the CALYX, or flower-cup; it proceeds from the external lamina of the cortex, as the corollæ themſelves did from the liber.

The whole of theſe parts taken together may be ſaid to conſtitute a vegetable ovum: ſometimes the ovum is found to ſprout from the root of

of the plant, ſometimes from the axilla or boſom of the leaf; and ſometimes it grows on a footſtalk ſingle and alone, as in tulips, lilies, &c. From what has been ſtated it appears that the cortical part of a plant progreſſively becomes calyx; the liber becomes corolla; the wood ſtamina; the medulla piſtillum; ſo that the fructification exhibits the internal part of a plant, naked and unfolded *.

If we take a curſory review of the different parts of which the vegetable ovum is compoſed, we ſhall be led to conclude, that the parts which are eſpecially deſtined to anſwer the end of vegetable exiſtence, are protected and preſerved by organs of an auxiliary nature; the ſeeds are protected and preſerved by the pericarpium, in which they are involved, and to which they are attached: the rudiment of the pericarpium itſelf is protected by the corolla, as the corolla is by the calyx.

If the duration of the efflorefcence be examined,

* This is the opinion of Linnæus, and which he particularly endeavoured to explain in the Diſſertation which he wrote on the Sexual Syſtem, and which has been tranſlated by Dr. Smith, the preſent very reſpectable Preſident of the Linnæan Society.

mined, we ſhall find, that in proportion as the pericarpium, with the ſeeds it contains, is evolved, and when it has attained a ſufficiency of power to reſiſt the immediate action of the elements to which it is expoſed, the whole of the effloreſcence withers and decays, and finally becomes ſeparated from the ſyſtem to which it belonged.

Of the Calyx in particular, and Foliage in general.

Whilſt theſe proceſſes take place in the effloreſcence, the calyx gradually expands: that protection which the corolla afforded to the fructification in embryo, the calyx ſeems to do in its adult or more advanced ſtate. It is very true that the ſituation of the calyx, with reſpect to the pericarpium, is more remote than that of the corolla, but the increaſed evolution which the fruit has ſuſtained does not ſeem to demand organs of defence ſo proximate as before: in proportion as the fruit acquires ſtrength by evolution, the calyx itſelf follows the fate of the effloreſcence; it decays and dies.

Although the fruit has loſt the protection of

of the calyx, it is not left altogether naked and expofed: in proportion as the efflorefcence and calyx wither and decay, a general evolution of the foliage begins, and the whole ultimately becomes expanded into LEAVES.

Of the Leaves.

It appears very probable to me, that the foliage is deftined to protect the adult fruit from the viciffitudes of the climate, and from the deleterious changes it fuftains, as the efflorefcence itfelf was deftined to protect the ovum in its infant condition. The leaves proceed from the cortical part of the vegetable frame, to which they are attached by the medium of a petiolus or footftalk: they are diftinguifhed by their fhape, their fize and colour. When a footftalk contains a fingle leaf only, fuch a leaf is called a fimple one: on the contrary, when one footftalk fupports two or more leaflets, it is then called a leaf compound: they are found in the trunk, but more efpecially in the different ramifications of the tree: an external epidermis protects a parenchymatous ftructure of a laminated form, containing juices of a green colour, fapid and

naufeous to the tafte. Leaves are generally of a green colour; the upper furface deeper than the lower one: the under furface is often white, and always paler than the upper one.

This variety would feem partly to arife from the influence which light has upon them; for, if plants be placed in rooms fo arranged, that the rays are admitted to a portion of the plant and excluded from the reft; the leaves of the firft fhall be perfectly green, while the appearance of the fecond will be pallid and white: but if the light be afterwards admitted to the whole, the palenefs difappears, and the vegetable green is re-produced *.

That the leaves of plants contain abforbent veffels in common with every other part of the furface of the plant, is not only obvious, but has been proved by various experiments. It would however feem, that this abforbent power differs in different parts of the fame leaf, and in the fame part of different leaves belonging

* This fact would feem to prove, that it is not the mere exclufion of light which accelerates the bleaching of endive: on the contrary, that it proceeds from the deprivation of it; and the accelerated decay it fuftains, by the increafed preffure it is made to undergo.

to the ſame plant. Some leaves abſorb equally well by both ſurfaces. In trees, abſorption is more abundant from the under than the upper ſurface; in herbaceous plants in general, the leaves are thought to abſorb more abundantly by their upper than their lower one; and finally French beans, and plants of that deſcription, are found to abſorb equally well by both. This abſorbent action of theſe veſſels varies under different circumſtances: it ſeems more active in young than in old trees, and in green flowers than in thoſe that are withering and verging to decay: and in dried leaves this power is totally loſt.

Dr. Prieſtley and other ingenious men have been at great pains to aſcertain what particular air it was which poſſeſſed the ſtrongeſt aptitude to be acted upon by the vegetable ſyſtem: they found by a variety of experiments, that carbonic acid air and azote were moſt greedily abſorbed; that vegetables vegetated and flouriſhed beſt in them; and therefore that they conſtituted the ſubſtances beſt fitted for their nouriſhment and ſupport. To theſe ſyſtems, therefore, theſe are the beſt and pureſt kind of airs that can be conceived. It is however very probable, that dif-

ferent ſpecies of vegetables require different kinds of air, as well as the ſame vegetable at different times. The fact however muſt not be omitted, that plants which nurſes of hoſpitals are in the habit of keeping in the wards, are found to grow with aſtoniſhing rapidity, ariſing no doubt from the nature of the air they abſorb, which to them is moſt ſalutary, although moſt noxious to the human frame*.

The

* When we ſpeak of air in general being pure or impure, good or bad, vital or azotic, we are in common too apt to confine our ideas to the human ſpecies alone, and to exclude the relation which it bears to other ſyſtems in general: it muſt however be very obvious, that the quality of food, the goodneſs or badneſs of it, is merely relative to the degree of aptitude which it poſſeſſes to be acted upon, and converted by the ſyſtem to which it is applied. Carbonic acid gas, therefore, with relation to the vegetable ſyſtem, is the pureſt and moſt vital air that can be conceived; it conſtitutes the beſt cordial that it can abſorb, as it is that which is moſt greedily devoured: ſo that when Dr. Prieſtley and others ſtate, that plants have the power of improving common air, of correcting and purifying bad air, they are not perfectly correct in their language. All air, or all food, is pure or impure, good or bad, in the degree in which it poſſeſſes the aptitude or inaptitude to be acted upon by any living ſyſtem, whether of the vegetable or of the animal kind: it is this relation on which

its

The abſorbent power of the veſſels which the leaves poſſeſs, has been eſtimated by different experiments. Branches of equal ſize, of apple, of pear, of cherry, and of apricot trees, have been placed in jugs filled with water, but very accurately covered over: the foliage was left entire upon ſome, from others it was ſtripped; the former abſorbed from fifteen to twenty, twenty-five and even thirty ounces of water in twelve hours of the day, whilſt the latter had abſorbed one ounce of water only.

In the month of Auguſt, an apple tree,

its goodneſs or badneſs depends. For example, we find various ſubſtances that become the moſt active poiſon to the human frame, but which prove very nutritious to brutes, as hemlock, &c.; and brandy itſelf, which is moſt deleterious to the infant, is frequently moſt beneficial to the adult ſyſtem. But why, it may be aſked, are ſubſtances preciſely the ſame in kind good and bad to different ſyſtems, or to the ſame ſyſtem, at different periods of life? The anſwer is obvious: Becauſe the one has the power of acting upon and aſſimilating them, which the other has not: to the one, they afford nouriſhment and ſupport; the other they act upon and kill. It is the ſame with the air they abſorb, with the medium in which they ſubſiſt, with the temperature in which they exiſt; and, in ſhort, with every circumſtance external to themſelves.

after having been weighed, was placed by the roots in a bucket full of water, the quantity of which had been previoufly eftimated: in ten hours during the day, the abforbents had taken up fifteen pounds of the water. It is by virtue of this abforbent power that flowers are preferved in water for a confiderable time, although feparated from the parent ftock, and that branches of trees are kept in a vegetative ftate, efpecially if the leaves are permitted to touch the water.

The organs I have defcribed conftitute the means by which the living power of the vegetable is able to act upon things foreign to itfelf, and affimilate them to its own nature, that it may attain the final caufe of its exiftence in the production of fructification. It is in the pericarpium, or fruit, in which the feed refides, and in which the living principle of the future vegetable is contained, by the power of which the propagation of the fpecies is effected.

Of the Seed.

When a feed is divefted of the pericarpium by which it is enclofed, the cotyledons appear, in quality, compofed of farinaceous matter, as

in

in corn, beans, peas, &c. in figure, lobular, which becomes ſeparable into two, in the centre of which the corculum, or heart of the ſeed, is ſituated: it is this part which involves within itſelf the living power of the future vegetable, the *punctum ſaliens* from whence the evolution proceeds.

The living and preſervative power of the vegetable ſeed is ſtrongly illuſtrated by a fact mentioned by Mr. Samuel Smith, and which he has recorded in the Tranſactions of the Bath Society for Agriculture. In the year 1754, his brother gathered at Straſburg ſome Indian corn, the ears of which he preſerved with the flag on it; it had lain by in this condition, having a label on it, with the name and place, when it was obſerved by the author of the Eſſay, the 28th of February 1788, at the diſtance of thirty-four years: he took ſix grains of it, ſoked them in water twenty-four hours, put them in pots filled with earth, and placed them in his hot-houſe, and in twenty days they began to appear, and ultimately grew to perfection.

Wonderful as this preſervative power may appear, it is not the utmoſt period to which it may

may extend. I have been informed by a friend, on whofe veracity I can rely, that he faw fome wheat laft year, which it was proved had attained the great age of eighty years, and which appeared as frefh, and whofe cotyledons were as full as if juft threfhed *.

When the feed is placed in a proper medium fit for its evolution, the cotyledon feparates into two; the corculum appears to develop itfelf; two parts manifeft themfelves, which immediately take very different directions: one part, which has received the appellation of roftellum, proceeds laterally downwards, forming the roots and radicles; the other, which is called plumula, progreffively afcends, pierces the ground, and conftitutes the trunk or ftem, from whence the ramification proceeds, with the various parts I have above defcribed.

The whole advances from infancy to old age and death, in a perpetual and uninterrupted courfe of progeffion, perfection and decay: it is therefore neceffary for me to ftate what

* When I ftated the extraordinary longevity of the vegetable fyftem, I omitted to mention, that the cedars now ftanding on Mount Lebanon are fuppofed to be 2,000 years of age.

are

are the parts which undergo thefe changes, and what appearances they manifeft; for we have feen that decay takes place in fome parts, whilft the evolution of others has fcarcely begun.

CHAP. II.

OF THE DECOMPOSITION AND DEATH OF THE VEGETABLE SYSTEM.

By decompofition the vegetable fyftem gives out various fubftances—different fpecies of air—gums, refins, &c. called fucci proprii—the tracheæ the media of excretion, &c. &c.

WHEN the rudiments of the feed are fufficiently evolved, which the pericarpium contained, and the pericarpium itfelf is fufficiently ftrong to refift the immediate action of the air, a confiderable excretion from the various parts of the efflorefcence immediately enfues, and

and which imparts the ſenſation of odour to the olfactory ſenſe; I ſay, a conſiderable excretion, becauſe it proceeds from a deprivation of the living power which thoſe parts originally poſſeſſed, by virtue of which they were preſerved in a ſtate of union with the ſyſtem to which they belonged, and of which they formed a part: but when theſe parts loſe the participation of this living power, which they had received, they loſe the harmony they poſſeſſed with the whole of the ſyſtem: they are therefore ſeparated from it, and excreted out of it *.

It is not the efflorefcence alone which gives out this excrementitious matter; it proceeds from the cortical part of the plant in general, and foliage in particular; it is effected by the action of a number of air-veſſels, which I ſhall

* Excretion, therefore, is the very reverſe and negative of digeſtion: digeſtion converts and aſſimilates foreign matter to the nature of the ſyſtem to which it is applied: it is by its power that this matter, once foreign, but now domeſtic, once dead, but now living, becomes in harmony with the whole, and anſwers the purpoſe for which it is deſigned, either with a view to its ſupport and evolution in general, or for the purpoſe of ſecretion in particular.

call TRACHEÆ *. They are eaſily detected by making a tranſverſe ſection of the ſtem, and are found diſpoſed and coiled up in a ſpiral form.

It is from theſe veſſels that the volatile parts of the plant are given out; in the ſame manner as the mephitic air from the lungs of animals during the act of expiration.

It is generally ſuppoſed that the tracheæ of vegetables perform the ſame office as thoſe of animals: it muſt however be remarked that a ſtriking difference does ſubſiſt between both; the vegetable ſyſtem firſt becomes evolved from the roots, where the tracheæ are ſcarcely apparent; the digeſtive proceſs goes on very perfectly from the cortical part of the root and trunk, without their aſſiſtance; they are found to exiſt more abundantly in the eſſloreſcence than in the foliage, more abundantly in the foliage than in the wood; the cortical part of the plant itſelf ſeems to be deſtitute of

* The tracheæ of vegetables are generally ſuppoſed to conſtitute the veſſels that abſorb air: it is very poſſible that they may at one time abſorb during the period of vegetation and of growth, and ſerve the further purpoſe of excretion when the plant is verging to decay.

them;

them; they therefore arife from within, and have no immediate communication without. On the contrary, the tracheæ of animals have a direct communication without, and are terminated by the lungs within; they not only appear to be different in their ftructure, but in the operations they perform. Animals that have lungs are perpetually indigent of air; and it is by the action of the lungs upon it, which the tracheæ (bronchiæ) had conveyed, that fanguification takes place, that new blood is formed and bad blood meliorated; fo that, if their actions were fufpended, the death of the animal would prefently enfue *.

On the contrary, the vegetable fyftem firft becomes evolved from its roots, where the tracheæ are fcarcely if at all apparent, the affimilating procefs goes on perfectly without their aid, and medulla is formed: it is after the medulla has been formed, that the *tracheæ* more evidently appear; it is after the evolution of the vegetable has proceeded to a confiderable extent, and more efpecially after the efflorefcence verges to decay, that they are

* Whilft its actions go on. For, in the fœtal and even torpid ftate, the lungs are in a paffive condition.

found

found in the greateſt abundance, after the foliage is formed *.

From a review of theſe parts, it ſeems moſt probable to me, that they are deſtined to convey, immediately from the effloreſcence and foliage, matter of a nature foreign and excrementitious; that it is through them that the volatile matter of perſpiration is conveyed to the cortical part, from whence it is expelled; that the groſſer parts are depoſited in the liber and cortex, where it undergoes a change, either ſpontaneouſly from the loſs of its living power, or from the action of thoſe parts of the plant itſelf, conſtituting the eſſential oils, the gums, and the reſins: the particular nature of the plant giving the diſtinguiſhing character to them, whether of cinnamon, of cinchona, or in ſhort of every other plant whatever. The excretion that takes place from different plants (and which may be called *ſuccus proprius*), produces a diſtinguiſhing

* There are ſome trees that may be ſtripped of their foliage almoſt totally without any detriment to their vegetative powers: it is often the caſe with mulberry trees, by the ravages they ſuſtain from the voracity of the caterpillar: it is always the caſe with the efflorefcence, which drops, as I ſaid before, at a very early period.

difference

difference in the properties which they feverally poffefs: this difference is more manifeft in old than in young plants, when the fyftem is verging to decay, than when it is in a ftate of high vegetation; the excretions are then more abundant, and the fenfible properties they poffefs are more apparent. Hence it is that the cortex of the cinchona is more bitter; of the oak more aftringent; of the cinnamon more aromatic; the juices of fruit more highly and diverfely flavoured. The fact is the fame with the excretion of animals, the fenfible properties being always more evident in the old than in the young: thus it is that urine is more faline, and fooner difpofed to decompofe and concrete; bile more bitter, &c. &c.

Such is the quantity of excretory matter that frequently flows from particular plants, more efpecially if the action of air be internally introduced by læfion of the epidermis, that the vafa propria burft, in which it is contained; the whole becomes effufed, either within the cellular membrane, or without the epidermis by which the cortex is invefted. In proportion as thefe fluids lofe their prefervative properties, they

lofe

lose their fluidity alſo, concreting into reſins, or coagulating into gums.

It is theſe various fluids in a coagulated or in a concreted form, which conſtitute the various medicinal ſubſtances now in uſe, and which produce ſuch beneficial effects upon the morbid ſtate of the conſtitution when judiciouſly adminiſtered. It is in the efflo-reſcence of the chamomile that its bitterneſs reſides; in the ſeed of poppies, the narcotic quality of opium; in the cortex of the oak, its aſtringency and antiſeptic power; in the root of rhubarb its bitter and purgative properties; in the bulb of the potatoe its nutritious qualities, &c. &c. &c.

Different chemiſts have been at conſiderable pains to analyſe and aſcertain the quality of the matter which was given out from the vegetable ſyſtem, as excrementitious and foreign, and which was found for the moſt part to conſiſt of oxygene or oxygenous air *. None have done it with more ſucceſs than Doctors

* As theſe experiments are well known by the generality of men, I ſhall not detail them, but muſt refer the reader to the different works in which they are eſpecially related.

Ingenhoufz and Prieftley: they found that this evaporific matter was given out more abundantly in the day than in the night; in the fummer than in the winter; in warm than in cold weather; and in the day when the fun was bright and brilliant than when clouded and obfcured.

The caufe of this decompofition would therefore feem to arife from the degree of action which the plant had previoufly fuftained. In the winter, when the plant was torpid; in cold weather, when its action was languid; or in the night, when its vegetative power was moft active, little or no decompofition took place: but in the middle of a hot fummer day, and more efpecially when brilliantly illuminated by the fun, the operation of thefe external caufes tended to fufpend the vegetative procefs, and to produce this decompofition in plants: hence it is, that in the day there is an increafed excretion from plants, and lack of vegetation; on the contrary, at night, or in moift and obfcure days, there is an increafe of vegetation, and a lack of excretion.

Dr. Hales found by experiment, that the great annual fun-flower perfpired even in a dry

dry night three ounces only; in a moift one not at all: on the contrary, during twelve hours of a dry day he found that it had perfpired no lefs than one pound fourteen ounces. Duhamel ftates that the cornel tree perfpires twice its own weight in twenty-four hours *. That thefe fubftances which are thus given out

* Il nous fuffit ici d'obferver, que l'eau qui doit porter les fucs nourriciers dans les fecrétoires, forme la plus grande partie de la lymphe qui eft afpirée par les racines, & qu'après avoir fervi à cet ufage, elle fort par les pores des feuilles fous la forme d'une vapeur infenfible.

Cette tranfpiration étant à peu près la dépenfe journaliere des végétaux, nous fert de mefure pour déterminer la quantité & les mouvemens de cette féve aqueufe que les racines doivent tirer de la terre pour y fuppléer: examinons donc, d'après les expériences de M. Hales, les phénomènes de cette tranfpiration.

On a pris un grand foleil de jardin, *hélianthus annuus*, qui avoit été élevé exprès dans un pot; on a couvert le pot d'un plaque de plomb laminé, percé de trois trous; favoir, l'un au centre pour laiffer paffer le tige de la plante; l'autre vers la circonférence, afin de pouvoir arrofer; & le troifiéme vers le milieu auprès de la tige, pour recevoir un tuyau de verre par lequel l'air pût communiquer fous la platine: on cimenta exactement toutes les jointures, & le trou deftiné aux arrofemens fût bouché avec un bouchon de liege. On pefa le pot matin & foir pendant un

mois

out are of an excrementitious and deleterious nature, is evident from the injury which the plant ſuſtains if they are retained, and the diſeaſe which conſequently enſues. If the

mois à peu-près tous les deux jours : deduction faite de deux onces par jour, pour ce qui s'évaporoit par les pores du pot, il reſultat qu'en 12 heures d'un jour fort ſec & fort chaud, la tranſpiration moyenne de ce ſoleil montoit à vingt onces, & à près de trois onces pendant une nuit chaude, ſeche, & ſans roſée : elle étoit nulle lorſqu'il y avoit eu tant ſoit peu de roſée : mais lorſque la roſée étoit aſſez abondante, ou que pendant la nuit il tomboit un peu de pluie, le pot & la plante augmentoient du poids de deux à trois onces.

Ayant meſuré exactement la ſurface de toutes les feuilles des racines, & la coupe horiſontale de la tige; on a trouvé que la hauteur du ſolide d'eau évaporé par la ſurface de toutes les feuilles étoit $\frac{1}{65}$ de pouce en 12 heures, $\frac{1}{65}$ de pouce pour celui qui a été aſpiré par la ſurface totale des racines, & de 34 pouces pour celui qui a paſſé par la coupe horiſontale de la tige. On a trouvé par de ſemblables expériences répétées ſur différentes plantes, que les ſolides d'eau tranſpirés en 12 heures de jour par la ſurface de chacune de ces plantes ſont de

$\frac{1}{165}$ de pouces pour le ſoleil,
$\frac{1}{191}$ de pouces pour un ceps de vigne,
$\frac{1}{86}$ de pouces pour un chou,
$\frac{1}{104}$ de pouces pour un pommier,
$\frac{1}{243}$ de pouces pour un citronier.

Dictionnaire Raiſonné des Arts & Sciences, &c.

principal

principal branches and leaves of a ſmall plant are varniſhed over, it withers and droops, and becomes pale; if the varniſh be removed, and the excretion permitted to go off, the part recovers again its priſtine vigour. The decompoſition that takes place from the excretory veſſels of the effloreſcence is ſoon followed by a mortification of the effloreſcence itſelf: the corolla, with the ſtamina and piſtilla, wither and decay, and a total ſeparation of them takes place from the ſyſtem to which they belonged, leaving the fruit in which the ſeed is contained to arrive at maturity and perfection. When the vegetable ſyſtem has attained this period of its growth, the aſſimilating power over external matter ſeems principally to be loſt, and its preſervative one only to remain; the ſyſtem ſeems to ſubſiſt for the moſt part on the medullary matter which had been previouſly formed, and which goes on in a regular and progreſſive aſcent, to ſupply the vegetation of the fruit to its ſtate of perfection: in annual plants, ſuch as barley, wheat, &c. this proceſs takes place in one ſeaſon, leaving the ſtem hollow in the form of ſtraw.

In trees, the medullary matter gradually for-

 ſakes

ſakes the roots, which it leaves hollow alſo, during the following ſeaſon. When the ſeed is perfected, the ſyſtem ſuffers a total waſte, until it becomes in a torpid ſtate; the power of the cortex and liber to form medulla is ſuſpended and loſt; the medulla itſelf is converted into lignum. It is then we ſay that the timber is ſeaſoned and fit for uſe: the medullary matter conſtituting the heart of oak, deſtitute of ſpecific action of vegetation, but full of its power of preſervation, like all other generated beings, gradually loſes its preſervative power alſo, crumbles to decay, and becomes decompoſed into its conſtituent parts.

CHAP. III.

OF VEGETABLE TEMPERATURE.

Experiment by Mr. Hunter, proving the power of ſap to reſiſt cold, and preſerve its natural ſtate when it exiſts in the ſyſtem—when taken out of it, congeals—the power of different plants to reſiſt cold proved—ſenſible heat and vitality evidently ſeparate things.

SUCH is the nature of the vegetable ſyſtem, that the temperature of its parts ſeems in a conſiderable degree to depend on that of the ſurrounding medium. Mr. Hunter, in a number of experiments which he made upon the ſap of different trees, found it frequently to be as low as 15 degrees of Fahrenheit, and that then it preſerved its natural and unfrozen ſtate; but, on the contrary, when it was taken out of the veſſels of the tree, it would freeze at the elevated temperature of 32°. The cauſe of this diverſity evidently aroſe from the different

circumſtances under which it was ſituated: in the one it was in union with the whole of the living ſyſtem, reſiſting, by virtue of its living power, the external operation of cold; its vitality therefore preſerved its fluidity: in the other, the loſs of vitality which the ſap had ſuſtained by ſeparation from the ſyſtem to which it belonged, weakened its powers of preſervation and of reſiſtance; it therefore underwent the ſame changes of congelation that matter of an inanimate kind is found to ſuſtain.

There are various plants that are incruſted, during the long period of a polar winter, with a caſement of ice, but whoſe living powers continue, although in a dormant ſtate: there are particular parts of particular plants whoſe power of reſiſtance is ſtronger than that of others; it is ſtronger in the roots than in the foliage, in the foliage than in the infloreſcence. I have ſeen a perfect and total exfoliation of all the leaves of ſome trees to take place in the month of September, in conſequence of a ſlight froſt. In the ſpring, the effect it has upon the infloreſcence need not be mentioned.

If

If the avena or oat, and the phaſcelus or kidney bean be torn up with their leaves, and expoſed to the temperature of 22°, the leaves die; but the roots, after a-while, begin to vegetate abundantly *.

When we reflect on the high degree of vitality which plants poſſeſs, and the low temperature of their parts, we ſhall be led to conclude that ſenſible heat and vitality are very different and ſeparable things; that although theſe ſyſtems feed principally upon carbon and azote, and give out oxygene, they are found to poſſeſs ſtronger powers of vitality than the higher order of animals, who receive oxygene for food, and give out carbon and azote as excrementitious, and whoſe temperature is as high as 98°, fifty or ſixty degrees higher than the vegetable ſyſtem.

I ſhall now proceed to enumerate, in a general

* There is an account given of a lake in the iſland of Luſon, which is ſo warm as to kill ſwallows flying over its ſurface; and yet hiſtorians of undoubted veracity tell us, that the *vitex*, *agnus caſtus*, and two ſpecies of *aſpalathus* grow on its ſhores. The ſoil of the iſland of Tanna, about the volcano, is 217 degrees of heat, and yet plants are found there bearing fruit in great perfection.

neral way, the other ſubſtances that are given out from the vegetable ſyſtem: it is foreign to my deſign to give a particular detail of them, to enumerate the various means that are employed for that purpoſe, or to ſpecify their chemical or medicinal virtues *.

The *ſuccus proprius*, which I have before mentioned, forms a ſtriking difference in different plants: in ſome liliaceous plants it is *green*; in the fig *lacteal*; in the celandine *yellow*; in the pine tree *reſinous*; in the maple *ſweet*; in the poppy *narcotic*; in the ſpurge *cauſtic*; and in many plants *bitter*; it eſpecially reſides

* Dr. Hooper, in a diſſertation which he has lately publiſhed on the economy of plants, has enumerated a number of facts with reſpect to the different ſubſtances that are obtained from different plants: many of the following obſervations are taken from him; and it may be proper to obſerve, that when he ſpeaks of theſe ſubſtances conſtituting the elements or principles of plants, he miſapplies the terms: moſt of them are truly excrementitious, and given out as foreign; they are no more the principles of the vegetable ſyſtem than urine or fæces are the principles of the human frame. I muſt refer the reader to the above book, and to Dr. Woodville's work on medical botany, as the latter contains not only the generic characters of different plants uſed for medicinal purpoſes, but an account alſo of their medicinal uſes.

between

between the cortex and liber; for, if an incision be made into these parts, it generally flows from thence.

From the nuclei of olives, walnuts, almonds, hempseed, linseed, ricinus, &c. &c. an unguinous oil is obtained, by mere expression alone: the seed is triturated and crushed by the pressure of a large stone, and reduced into the form of a paste: the whole is then put into bags, the bags are squeezed by means of a press, the oil is forced out of the seed, and collected in proper vessels. Plants, when exposed to the action of heat by distillation, yield a quantity of oil also; these oils are called essential, and have properties very different from the foregoing.

From the mimosa Nilotica, the gum arabic spontaneously exudes; and it is by the same process taking place in different trees, that the gum senegal, gum tragacanth, and various others are obtained.

From gums, strictly so called, a difference takes place, into what are called gum resins, as the assa foetida, galbanum, ammoniacum, myrrh, &c. &c. &c.: and, finally, from gum resins

resins there is another variety to pure resins alone.

When incisions are made into the trunks of the *laurus camphora*, large drops progressively get between the liber and cortex, which coagulate into a concrete substance, known by the name of camphor. The *copaifera officinalis*, *amyreis gileadensis*, *toluifera balsamum*, *pinus balsamea*, &c. treated in the same way, yield balsams, that derive their appellation from the names of the plant by which they were produced: they are frequently so abundant that they flow spontaneously: by analysis these balsams are found to consist of a resinous substance, dissolved in ethereal oil.

If incisions be made in the leaves of the *aloe socatorina* or aloe plant, a bitter fluid flows very plentifully from the incision, which coagulates also, forming the gum aloes in medicinal use.

Opium is obtained by nearly the same means: when the pericarpium is divided, the juice flows through the divided part, and is collected. The leaves of the *tobacco plant*, *hemlock*, *laurocerasus*, &c. produce fluids of a similar kind.

The

The refinous matter is found in very abundant quantity refident in the bark, roots, and leaves of moft plants: it is eafily feparated, by the action of alcohol, from the woody fibres: if the whole be expofed to a moderate heat, the fpirit evaporates, and the refin is left behind.

From the antheræ of moft plants, and from the fruit of many, a waxy matter is obtained; a melleous fubftance from the ftigmata, which is found by chemical analyfis to be compofed of fugar diffolved in mucilage; and a balfamic one, containing grains of cryftallized fugar, in the nectaria of fome plants.

From the root of the potatoe, from yams, from the feeds of cereals, and by feparating the internal from the external, the fine from the hufky parts, as chefnuts, &c. a farinaceous matter is obtained; by decompofition it is found to be compofed of vegetable gluten, of an amylaceous matter with mucilage.

In dates, figs, filiquæ dulces, caffia in the pod, raifins, apples, quinces, plums, cherries, mulberries, currants, a faccharine fubftance is obtained; but in none is it obtained in fuch abundance, as in the arundo faccharifera or fugar

cane:

cane: in the Weſt and Eaſt Indies, where it is cultivated, the ſugar cane is bruiſed between two iron cylinders: the juice called melaſſes is thus expreſſed; and by various other proceſſes it is further depurated and purified, and made into ſugar.

From the *acer ſaccharifera* and *fraxinus ornus*, manna is obtained, and which flows ſpontaneouſly from the cortex: this ſaccharine matter may likewiſe be obtained from carrots, parſnips, the roots of dandelion, ferns, liquorice, and from moſt other plants.

If the leaves of the *ſaponaria officinalis*, or ſoap-wort, be dried and powdered, it waſhes greaſy ſpots out of linen with water, and froths like ſoap: this ſaponaceous matter is found alſo in the nuclei of the *ſapindus*, the roots of the *cichorium ſarſaparilla*, *aſtragalus exſcapus*, &c. &c.

From the leaves of the *thea bohea*, betula alnus, and *arbutus uva urſi;* from the petals of the *roſa centiflora*, *gallica*, *canina* and *punica granatum*, an aſtringent matter is obtained, which is found to conſiſt of the gallic acid and gum; it abounds alſo in the galls of the oak, in the inſpiſſated juice of the *mimoſa catechu*, *i. e.*

terra

terra japonica; in the bark of the fruit of the pomegranate and walnut, oak bark, &c. &c. &c.

From the ſtalk of the *indigofera tinctoria*, or indigo plant, by maceration in water, and the precipitation of the fæculum, the indigo blue is obtained. A vegetable acid is alſo procured from the root of the rubia tinctorum, or madder, and from the wood of the *cæſalpina veſicaria*; and finally, a yellow colour is obtained from the *carthamus tinctorius*, *crocus ſativus*, *ſerratula tinctoria*, amomum curcuma, geniſta tinctoria, &c.

Beſides the vinegar obtained from moſt vegetables by the proceſs of fermentation, the fruits of many contain particular acids, diſtinguiſhed by the nature of the ſyſtem by which they are produced. The *tamarindus gallica* produces the tartaric acid: the gallic acid is detected in all aſtringent plants, in combination with gum; the citric acid is obtained from the fruit of the *citrus medica* and aurantium, *limonia acidiſſima*, *rubus idæus*, *ribes rubra & groſſularia*, *pinus ceraſus*; the malic acid reſides in the fruit of the *pyrus malus*, cydonia, &c. &c. &c. &c.

It

It appears, from all vegetable ſubſtances, by chemical decompoſition, that there is obtained a quantity of alcaline matter, varying in its proportion and properties in different plants. Marine vegetables furniſh ſoda; land vegetables pot-aſh; and it is theſe two that conſtitute the baſis of ſeveral other ſalts.

The Linnæan Mode of Claſſification.

Various have been the modes which different botaniſts have adopted to ſimplify the ſtudy of botany, by reducing the multitude of plants into different claſſes. Dr. Kentiſh, in an Eſſay which he wrote in the year 1782, has collected the whole of them, and which he has detailed in a very perſpicuous and ſpirited manner. By ſome Botaniſts, plants are arranged in an alphabetical order; by others according to the time of flowering; ſome according to the different places of their growth; others again from the form and diſpoſition of their roots, leaves, flowers, or fruit; the particular mode of growing, flowering, or foliation. Hence the diviſion of trees into pomiferæ, nuciferæ, bacciferæ, pruniferæ, glandiferæ, &c. Of herbs, into bulboſæ, ſiliquoſæ, umbelliferæ,

belliferæ, verticillatæ, papilionaceæ, &c. There are classes or orders which Nature herself has instituted, and it is the grand desideratum of botany, to reduce and connect all vegetables according to such a natural method: in this point, however, the most sanguine endeavours have hitherto proved ineffectual; I shall therefore confine myself to notice the Linnæan mode, as it is the one in general estimation, and appears to be an improvement upon all the rest.

Charles Von Linnè, or (as he was commonly called) Linnæus, was the son of a Swedish Divine, and born at Roeshult, in the province of Smaland, in Sweden. There is something botanic in the very name of Linnæus; for the ancestors of this family are said to have taken the sirnames of Linnæus, Lindelius, and Tiliander, from a large lime-tree, or linden-tree, yet standing on the farm where this naturalist was born. Such an origin of sirnames is not uncommon in Sweden. After struggling with the difficulties of adverse fortune, this great man arrived at honour and independence. He was made Professor of Physic and Botany in the University of Upsal,

Phyſician to his Sovereign, and Knight of the Order of the Polar Star. In 1757, he was ennobled, and on the reſignation of his office had his penſion doubled, and a liberal donation of landed property ſettled on him and his family. He died January 11, 1778, aged ſeventy years and eight months. It is, however, foreign to our purpoſe to purſue the biography of any one in particular. The diſtinguiſhed eminence of Linnæus can alone excuſe the preſent digreſſion. We ſhall therefore return to give a ſketch of the botanic ſyſtem of this great man.

Linnæus very early attempted a natural method of arrangement; but he ſoon found that too many links are wanting in the chain to render it the readieſt guide to botanical ſcience. He only reduced the genera into orders, but did not venture to form the claſſical part of a ſyſtem on that plan. He made an attempt to fix the *calyx*, or *cup* of the flower in plants, as a ſource of arrangement, in which he ſeems to have followed Profeſſor Magnol, of Montpelier, who publiſhed in 1720. But he ſoon rejected all theſe methods, and was the firſt who conſtituted the ſtamina and piſ-

tils,

tils, as the basis of an artificial method of arranging plants. He was led to this by considering the great importance of these parts in vegetation. He maintained, that they alone are essential to fructification, since all other parts, except the *anthera* and *stigma*, are wanting in some flowers. The present philosophy of botany regards the former as the male, and the latter as the female organs of generation in plants. From this distinction of the sexes of vegetables, the arrangement of Linnæus is known by the name of the Sexual System. It consists of 24 classes, and their characters are established upon the number, situation, or arrangement of the stamina, or male organs. The orders or subdivisions of these classes are, as far as possible, drawn from a similar number, situation, or arrangement of the pistils, or female organs. In the first twenty classes are contained such flowers as have the stamina and pistils both within the same cup or petals, or standing on the same receptacle where these are wanting. The author calls them hermaphrodite: as according to his doctrine there are both male and female parts in the same flower.

The firſt ten claſſes proceed in an uninterrupted ſeries, from Monandria to Decandria; the plants of each having as many ſtamina as the title expreſſes: thus, 1. Monandria, Stamen unicum in flore hermaphrodito. 2. Diandria, Stamina duo in flore hermaphrodito. 3. Triandria, Stamina tria in flore hermaphrodito, &c.

The eleventh claſs is Dodecandria, Stamina duodecim in flore hermaphrodito. For it is very remarkable, that no plants yet diſcovered have exactly eleven ſtamina.

The twelfth, Icoſandria, containing ſuch plants as have about twenty ſtamina, or more, ariſing from the *calyx*, or *corolla*, and not from the receptacle.

The thirteenth, Polyandria, may have the ſame number of ſtamina as the former, but they ariſe from the *receptacle*, and are commonly very numerous.

The fourteenth claſs, Didynamia, comprehends ſuch plants as have four ſtamina, two long, and two ſhort. This includes vegetables of a very particular deſcription, the eſſential character of which does not conſiſt in the number, but ſize and peculiar form of the ſtamina,

mina, two of which are uniformly ſhorter than the other. The corolla is irregularly ſhaped, and there is only one piſtil.

The fifteenth, Tetradynamia, includes plants with ſix ſtamina, four of which are longer than the other two.

The ſixteenth, Monadelphia. In this the ſtamina are not diſtinct at the baſe, but united into one body.

The ſeventeenth, Diadelphia, in which the ſtamina are united at the baſe into two bodies.

The eighteenth, Polyadelphia. In this the ſtamina are united at the baſe into ſeveral bodies.

The nineteenth, Syngeneſia, in which the antheræ unite together ſo as to form a tube or cylinder, through which the piſtil commonly aſcends.

The twentieth, Gynandria, in which the ſtamina proceed from the piſtil, and not the receptacle.

The twenty-firſt, Monœcia; ſuch as have ſeparate male and female flowers on the ſame plant.

The twenty-ſecond, Diœcia, ſuch as have

ſeparate male and female flowers on ſeparate plants.

The twenty-third, Polygamia. In this claſs, beſides the hermaphrodite flowers, there are others, either male or female, in the ſame plant.

The twenty-fourth, Cryptogamia. In which are contained thoſe plants, the mode and organs of whoſe fructification are not yet ſufficiently aſcertained. They have been called imperfect plants, and it may juſtly be ſaid of them, "Parvitate oculos noſtros ſubterfugiunt."

The orders of the ſyſtem are for the moſt part taken from the number of the piſtils, or female parts. Thus in the firſt thirteen claſſes, in which the claſſical character depends uninterruptedly on the number of ſtamina, the orders depend likewiſe on the number of piſtils; but when ſituation or different arrangement takes place, they are moſt commonly founded on other diſtinctions. Thus the Didynamia has the two orders of Gymnoſpermia and Angioſpermia: the former having four naked ſeeds, and the latter having the ſeeds incloſed

in

in a ſeed veſſel. In the Tetradynamia, the two orders of Siliculoſa and Siliquoſa are taken from the ſize and ſhape of the pod or ſhale; in the former of which it is ſhort, and in the latter long. In the claſſes of Monadelphia, Diadelphia, and Polyadelphia, the orders are formed from the number of the ſtamina. In the Syngeneſia claſs there are two general ſubdiviſions or orders, Polygamia and Monogamia; the firſt of which is divided into five leſſer diviſions, as Polygamia Æqualis, Superflua, Fruſtranea, Neceſſaria, Segregata. The differences here ariſe from the different ſtructure or ſex of the Floſcules, conſtituting the whole flower.

In the Gynandria, the orders are taken from the number of the ſtamina, as in the ſixteenth, ſeventeenth, and eighteenth claſſes.

In the Monœcia and Diœcia claſſes, the characters of the orders are drawn from the characters of the foregoing parts of the ſyſtem as far as to the Monœcia claſs itſelf; the firſt order of which contains Monandrous, and the laſt order of the *Diœcia* Gynandrous plants.

The orders of the Polygamia contain the Monœcious, Diœcious, or Triœcious plants.

The orders of the Cryptogamia clafs are Filices, Mufci, Algæ, and Fungi.

Of the Modes of Propagation in Vegetables.

Such is the perfection of the vegetable fyftem, that it is provided with various means by which it attains the final caufe of its exiftence. The propagating power of vegetables in many inftances is not confined to one mode alone, as in the higher order of animals, but it extends to feveral: the offspring which is in confequence produced, is as perfect in all its properties, whether it has been evolved from a flip or from a bulb; from a bud or from a feed. If the branches of a tree be cut off, fuch is the high degree of living power every part effentially contains, that radicles will be produced, and a whole fyftem perfectly developed: the fame effects are found to enfue from the power of buds as well as of bulbs; and in various inftances a perfect tree will be elongated from the inhumation of one fingle leaf. In fome plants, indeed, the propagation that takes place by the feed, which the efflorefcence has produced, is not only more uncertain than when it is evolved from the bulb,

or

or the mere root itſelf; but the fœtus which is formed by the one, becomes baſtardized, and participates leſs of the nature of the parent ſtock, than that which proceeds from the other. For example, in the whole tribe of carnations, the ſeeds they produce are for the moſt part ſterile: inſtead of evolving ſyſtems when placed in proper media for that purpoſe, they generally wither and decay: if any there be that are prolific and germinate, they are ſeldom of the ſame ſpecies as the parent ſtock, but an hybrid breed is the conſequence. On the contrary, when the ſpecies is propagated by means of ſlips, where no ſexual intercourſe can have had an influence, the ſyſtem which is evolved from the ſlip always reſembles the parent from whence it was ſeparated. Theſe facts are particularly ſtriking in potatoes. The apples or ſeeds that are produced from the efflorefcence (in which the ſexual organs are ſaid to reſide) are generally barren. When they occaſionally vegetate and prove prolific; not only a degenerate but a baſtard offspring is produced. On the contrary, when the bulb of the potatoe plant itſelf is cut and divided into ſeveral and ſeparate parts, each portion is found

to

conftitute a perfect ovum, in which the living power refides; by the energy of which the fpecies is propagated the fame in kind as the parent itfelf. And finally, moffes and other vegetables of the moft fimple, and therefore of the moft perfect kind, poffefs this prolific power in fo abundant and exquifite a degree, that they can propagate their fpecies with equal perfection in different modes, not only by feeds and by roots, but by branches and buds *.

This

* Thefe effects are conformable to the hiftory of creation, which we have fo beautifully detailed in the 1ft chapter of Genefis, when God faid, "Let the earth bring forth grafs, the herb yielding fruit after his kind, and the tree yielding fruit *whofe feed* IS IN ITSELF after his kind: and the earth brought forth grafs and herb yielding feed after his kind, and the tree yielding fruit whofe *feed* WAS *in itfelf* after his kind, and God faw that it was good."—But when the infpired author relates the generation of the human fpecies in particular, he exprefsly fays, "So God created man in his own image, in the image of God created he him; *Male* and *Female* created he them." Here there is the effential power of propagation in Vegetables, without fexual intercourfe, particularly marked out, and the abfolute exiftence of different fexes, male and female, in the human fpecies, that might be "fruitful and multiply, and replenifh the earth, and fubdue

This extended and diverſified power of propagation is not confined to theſe vegetables alone, it extends to other ſyſtems alſo: it is particularly notorious in the *polypus*, in that queſtionable ſyſtem which forms the connecting medium between the vegetable republic and the animal kingdom: it ſeems to be an animated being where the living power abounds in the moſt eminent and perfect degree, poſſeſſing organs that are alone deſtined to diſplay its energy in the acts of aſſimilation and propagation: it poſſeſſes the power of cicatriſing any læſion its parts may have ſuſtained*. And

ſubdue it; and have dominion over the fiſh of the ſea, and over the fowls of the air, and over every living thing that moveth upon the face of the earth."

* In one of my walks, ſays Profeſſor Blumenbach, I diſcovered, in a ſtream, a ſort of green armed polypus, which differed from the common green kind by its long ſpiral body, and by having ſhort and rather immoveable tentaculæ: the hardy conſtitution of the polypus itſelf, and the warmth of the weather, forwarded the experiments which we made to diſcover its power of re-production ſo much, that the act of renewal of the parts became almoſt perceptible. By the ſecond or third day, the maimed and divided animal was ſo many new ones, each with arms, body, tail, &c.; but we remarked, that the regenerated animals,

And finally, if it be divided into different parts, each of the divided parts from that inftant conftitutes a *whole*, poffeffing in a very perfect degree the power of affimilating the fubftances by which it is furrounded, and a perfect evolution of a complete fyftem confequently enfues. It may therefore be ftated as a fact, that the loweft order of the animal fpecies in particular, and the vegetable in general, may be propagated by means totally independent of the action of the fexual organs it is imagined they poffefs; although thefe organs are neceffary to the production of feed, and therefore are effential to thofe particular vegetables that are propagated by that mode alone. The variety of experiments which Linnæus inftituted to afcertain the fact, feem to prove that fœcundation does take place, and that the

animals, although fupplied with plenty of food, were always much fmaller than before, and a mutilated rump always diminifhed very evidently, both in length and diameter, in proportion as the loft parts were renewed. p. 18. Tranflated by Dr. Crichton.

It would therefore feem, that the divifion may be extended fo far as to weaken the power of life, to the degree of annihilating the propagating power of the animal itfelf.

pollen,

pollen, which the ſtamina ſecrete, conſtitutes the agent by means of which it is effected; ſo that, unleſs it paſſes to the ſtigma of the piſtil, ſterility conſequently enſues. It muſt however be remarked, that the utmoſt caution ought to be employed in drawing a general concluſion from the reſult of particular experiments. General concluſions ſhould only be drawn from an uniformity in the reſult of moſt experiments that are tried upon the ſame ſubject.

I ſhall think it right to examine the ideas that Linnæus entertained of the vegetable anatomy, becauſe they ſeem to be intimately connected with the reaſons that led Linnæus to form his opinion of the ſexual ſyſtem. I have appealed to Dr. Smith's elegant tranſlation of Linnæus's Diſſertation upon this particular ſubject, written after the Amœnitates Academicæ.

The Opinion of Linnæus of the Anatomy of Vegetables.

The manner how the propagation of the vegetable ſpecies was effected has been a ſubject of much controverſy amongſt Phyſiological Botaniſts. Tournefort, Pontedera, and

and others, have ſuppoſed, that it was completed by the vegetative power of the plant alone, independently of any ſexual intercourſe: on the contrary, it was the opinion of Linnæus, the greateſt botaniſt that has ever exiſted, that it was the conſequence of ſexual intercourſe in common with the other ſpecies of the animated creation.

The magazine of ſcience with which Linnæus was filled, led him to ſee the neceſſity of tracing the chain that pervades throughout the whole of animated exiſtence, for the purpoſe of arriving at a knowledge of the cauſe, by means of which the effects we behold were immediately produced: he therefore recommends us (page 9) " firſt to contemplate the operation of Nature in the human frame, and from thence to continue our reſearches throughout the various tribes of quadrupeds and birds, from reptiles to fiſh, from inſects to worms, until we deſcend, and finally arrive at the vegetable creation *.

Although

* It is ſomewhat extraordinary to me, that the great Linnæus himſelf, the man of ſcience and of erudition, ſhould recommend, as the ſcientific inveſtigation of a ſubject, proceeding from ſyſtems the moſt complicated and compound, to the moſt ſimple and obvious: that Linnæus the Botaniſt

Although he allows that in a ſurvey of this vaſt chain he beholds the analogy and ſameneſs that ſubſiſt between the contiguous links of which it is compoſed; he acknowledges that the beginning is totally different from the end, and the human from the vegetable ſpecies. The cauſe of this diverſity he very rightly aſcribes to the difference in the organization between both: he ſays that the human body is compoſed of a double principle, the nervous and the vaſcular, or, what he conceives to be the ſame thing, a medullary and a cortical ſubſtance: by the former (the medullary) "I mean, ſays he, the ſpinal marrow ariſing from an organized brain, and ſending off nerves; by the latter (the vaſcular ſyſtem), the veſſels with the heart attached to them, and by which the medullary part is nouriſhed."

It is not only this brain, ſpinal marrow, and nerves which diſtinguiſh the higher order of animals, but various organs of ſenſe alſo, by

niſt ſhould expreſsly recommend the examination of the moſt complicated animal, as the only means by which the organization and function of the moſt ſimple vegetable can be underſtood—although he expreſsly declares that we are *totally in the dark* as to the mode by which the propagation of the ſpecies in them is effected.

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which they are able to perceive external objects, and perform ſome functions peculiar to themſelves, and which are partly denied to the lower claſs, and altogether to the vegetable creation; the latter, he confeſſes, are entirely deſtitute of ſpinal marrow, brain, and nerves.

We may, therefore, be permitted to conclude, not only from the knowledge we poſſeſs of the vegetable anatomy, but from the high authority of Linnæus himſelf, that vegetables are compoſed of a ſingle principle (the vaſcular), and not, like the higher order of animals, of a double one, namely, the medullary and vaſcular united, and that they are conſequently unable to move ſpontaneouſly like animals, behold external objects, or act from any motive of rationality, by means of which the ſexes of animals are diſtinguiſhed and aſcertained, and ſexual intercourſe effected.

Although Linnæus aſcribes to animals alone a nervous or medullary ſyſtem, in which ſenſation and voluntary motion eſſentially reſide; although he acknowledges that vegetables are altogether deſtitute of either ſpinal marrow, brain, or nerves, he proceeds immediately after

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to ſay, "that plants, like animals, conſiſt of two different ſubſtances, the *medullary* and the *cortical:* the cortical part nouriſhes the plant, (it ought to have been ſaid, conſtitutes the organ through which nouriſhment is obtained): on the contrary, the medullary part is multiplied and extended without end, and whenever it is loſt the death of the plant neceſſarily follows; ſo that it would ſeem that the cortical part is analogous to the digeſtive and aſſimilating organs of animals, and the medullary part, as its name imports, is analogous to the nervous ſyſtem, the brain and ſpinal marrow included, which is inveſted by the wood; and which, he conceives, performs the office of bones *."

That

* That he ſuppoſes the medulla of plants to be analogous to the brain and nerves of animals, is very evident from what he farther ſtates upon the ſubject (page 14): "In thoſe animals whoſe ſpinal marrow is ſurrounded by a bony covering, as in the large and more perfect kind; this ſubſtance never comes out of its confinement, and the harder its caſe is the more is its increaſe prevented: but in the ſmaller tribes of worms, where this covering is leſs rigid, a perpetual and unlimited increaſe of theſe animals takes place, as in vegetables." He before ſtated, that, in vegetables, this medul-

That this conclufion is an erroneous one, is evident from the diftinguifhing characteriftic which Linnæus himfelf has made between an animal and a vegetable; an animal having a double principle, namely, an organized brain, fpinal marrow and nerves, with a vafcular fyftem: whilft on the contrary, vegetables have a fingle principle only, viz. a vafcular one. Inftead, therefore, of fuppofing that the medulla of vegetables is analogous to the fpinal marrow, brain and nerves of animals, he ought to have faid that it was analogous to their blood, which was difperfed, as we have feen before, throughout the whole of the vegetable fyftem, for the purpofe of its evolution and growth, like the blood of animals. The perfection of this vafcular fyftem is the caufe why vegetation is fo complete: it is owing to the privation of a nervous fyftem that they are deftitute of confcioufnefs, of fenfe, and, I may add, of voluntary motion alfo: it is from the nature of this conftruction that they become to us more

lary matter, this effential part, was multiplied and extended without end, and the death of the plant was the confequence of its lofs.

immediate

immediate objects of nouriſhment and ſupport, more ſubſervient to our uſe; that we are able to deſtroy them without inflicting any ſenſation of violence, or occaſioning to them any pain.

If we were to ſuppoſe that the medulla of vegetables performed the ſame office as the brain of animals, we muſt alſo allow that its power of action depended on the proportion of its magnitude to the ſyſtem at large. The conſequence would be, that vegetables would poſſeſs more brain than animals, with ſmaller ſtomachs, ſtronger organs of ſenſation, and weaker organs of digeſtion. The caſe would be actually reverſed, for no doubt can ſubſiſt but that the living power of vegetables is more perfect than that of animals; more perfect in the more ſimple than in the more complicated; in the moſt inſtinctive than in the moſt intelligent; in brutes than in the human ſpecies. The former poſſeſs more vital power, and leſs nervous energy; ſtronger organs of digeſtion, and weaker organs of volition and of ſenſation: they poſſeſs large ſtomachs, and ſmall brains; the latter poſſeſs large brains, and ſmall ſto-

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machs: it is in the moſt rational ſyſtems of the whole—in the human ſpecies—that we behold the comparative ſterility of their frame, and their dependent ſtate, totally indigent until the dormant faculties of the mind become rouſed and excited, and capable of directing the various organs of voluntary motion to their proper end. Vegetables poſſeſs vegetable life with vegetable action: animals, in their fœtal ſtate, poſſeſs animal life with vegetable action; in the adult ſtate, animal life with animal action: the human ſpecies, animal life with voluntary and intellectual action: and, finally, we may preſume that in the future ſtate it ſhall enjoy a Spiritual Life, with ſpiritual action alone. This is the chain which the ſcientific Linnæus recommended us ſo ſtrongly to trace, with a view of ſeeing the difference that ſubſiſted between the extreme parts; but which he certainly inveſtigated with a view not to difference, but to analogy and ſameneſs, and becauſe he ſaw the neceſſity of ſexual intercourſe in the higheſt and moſt rational ſyſtems, the means of propagating the ſpecies: he concluded, that the analogy of ſameneſs ſubſiſted

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in vegetables alſo, in thoſe ſyſtems that were differently conſtructed, and whoſe actions were conſequently totally different.

Of the Sexual Syſtem.

It ſeems very evident to me, that Linnæus was led to form his idea of the ſexual ſyſtem in vegetables, by the neceſſity that exiſts of ſexual intercourſe for the propagation of the ſpecies in the higher order of animals: it was owing to this tendency that he has been led to great inconſiſtency in the anatomy of the vegetable ſyſtem: inſtead of aſcribing to the medulla the ſame office as that of blood, he ſuppoſed it to be analogous to the ſpinal marrow of animals. The neceſſity of ſexual intercourſe, in the moſt complicated ſyſtems, is a ſtrong preſumptive proof to me that no ſuch neceſſity does exiſt in the loweſt order of animals in general, or vegetables in particular; becauſe no analogy can ſubſiſt between beings that are totally different in their conſtruction, totally different in their mode of exiſtence, as alſo in the operations they perform. With a view of accommodating the actions of theſe different and diſcordant ſyſtems, and drawing

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an analogy of ſameneſs between them, it was neceſſary to aſcribe to ſome of the parts of the infloreſcence the ſame functions as thoſe of the ſexual organs of the higher order of animals; and to diſtinguiſh plants into male, female, and hermaphrodite.

Linnæus ſuppoſed that the powder which the anthera produced conſtituted the ſemen maſculinum, or impregnating duſt; that the piſtillum, which is ſituated internally to the ſtamina, and which forms the female organs, receives, by its ſtigma or ſummit, the pollen which is ſhed from the anthera or ſummit of the ſtamina. It is not ſuppoſed that the pollen paſſes through the ſtyle into the pericarpium, but that the ſtigma, which is moiſtened with a fine dew, preſents itſelf to receive the pollen, by which it adheres.

Theſe are the means which it is thought vegetables employ to celebrate their marriage, or connubium, and the mode by which it is conſummated.

In the claſs of monœcia, where the flowers are ſingle, the male and female ſeparate, either upon the ſame or different branches, Linnæus imagined that the pollen is conveyed from the anthera

anthera to the ſtigma by the force of the wind, or through the medium of inſects. It ſeems, however, very improbable to me that the air, much leſs inſects, ſhould conſtitute the media of communication between the ſexes*, becauſe Providence has in no one inſtance had recourſe to ſuch extraneous means, where an effect was to be produced that required immediate union: it is ſexual union by means of ſexual ſeparation. It might indeed be aſked, what could be the object of ſexual intercourſe, without any conſciouſneſs of ſexual attachment? what the uſe of organs of ſenſe, whilſt deſtitute of the faculty of ſenſation? or, what could be the object of ſentient powers in ſyſtems the final cauſe of whoſe exiſtence is the propagation of the ſpecies alone †? It requires, indeed,

* If we admit the ſexual ſyſtem, we muſt conceive the analogy to ſubſiſt in the mode by which fœcundation takes place in vegetables as well as in animals.

† Since the foregoing ſheets have been ſent to the preſs, I have paid particular attention to the great ſun-flower, which has been generally cited for the extent of its intelligence, becauſe it was ſuppoſed to preſent the front ſide of the bloſſom to the rays of the ſun, and in the moſt bare-

indeed, the elaſtic force of human imagery to conceive that theſe parts are endowed with ſenſitive faculties, and that they poſſeſs a nervous ſyſtem: it has never been detected; and, if I were permitted to reaſon from the rank which vegetables hold in the great chain of animated exiſtence, I ſhould conclude that they are totally deſtitute of one. To eſtabliſh the truth of the ſexual ſyſtem, in its fulleſt extent, it is neceſſary to prove, what facts abſolutely deny, that ſterility unavoidably enſues without ſexual intercourſe, and that it is a *ſine quâ non* to the propagation of the ſpecies. That it is not a *ſine quâ non* has been proved by the experiments of different eminent botaniſts on diœcious plants. Jacob Camerarius, as well as Dr. Alſton, ſelected female plants of the mercury, ſpinage, and even of hemp itſelf, and tranſplanted them at a great diſtance from any males of the ſame genus: they took the additional precaution to have them encloſed

faced manner to commit the ſexual act in its preſence; and I am happy to ſay, that thoſe which grow in the pariſh of Newington Butts are guilty of no ſuch obſcenity: I have found that there were as many that turned their back ſide to the ſun as there were that faced it.

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by a double row of hedges; but, ſo far from ſterility being the conſequence, they produced a large quantity of fertile ſeed. Tournefort made the ſame experiment on the *lupulus*, Miller upon the bryony, and Geoffroy upon the mays; and all of them declare, that the ſeeds of theſe plants were as fertile as if they had been ſurrounded by a thouſand males.

It is, however, impoſſible to do away the crowd of facts which prove the power which the pollen contains, and the faculty it has of imparting the character of the ſyſtem from whence it was produced, to the ſyſtem by which it is received: that it does contain this power, is proved by the variety of hybrid productions that are the conſequent reſult.

The antheræ of a plain coloured tulip were removed, and the ſtigma was then rubbed with the pollen of another, of one of a different colour: the year following, the tulip which had been deprived of its antheræ partook of the colour of the coloured one.

In the caſe of the melon and cucumber, they not only bear flowers male and female, but, if either are ſtripped off, the reſt are

barren:

barren: and I have been informed by a very intelligent gardener, that if cucumbers, of different ſpecies, be ſown in the ſame bed, an hybrid production is frequently the conſequence. The ſtory from Ray, of Richard Baal, the Brentford gardener, is particularly in point: this man having ſold a quantity of the *braſſica florida* to ſeveral gardeners near town, the ſeeds of which were ſown as uſual; the ſeeds, inſtead of producing plants of the braſſica florida, which the gardeners had purchaſed, turned out to be thoſe of the braſſica longifolia. A proſecution was commenced by the gardeners againſt poor Baal in Weſtminſter Hall. The court found him guilty of fraud, and condemned him not only to reſtore the price of the ſeeds, but likewiſe to pay the gardeners for the loſs of labour and the uſe of the ſoil. Linnæus ſhrewdly obſerves, that the judges were no botaniſts. Had they been acquainted with the ſexual hypotheſis, Baal would have been acquitted, and the accident aſcribed to the fortuitous impregnation of the braſſica florida by the pollen of the braſſica longifolia.

I ſhall paſs over the well-known mode of propagat-

propagating the palm-tree, as defcribed by Dr. Haffelquift, and confine myfelf to relating the facts which Linnæus conceived proved in a decided manner the truth of this hypothefis. "I fowed, fays he, the feeds of hemp (cannabis) in two different pots, in the month of April; the young plants came up fo plentifully that each pot contained forty. I placed each by the light of a window, but in different and remote apartments: the hemp grew extremely well in both pots: in one of them I permitted the male and female plants to remain together to flower and bear fruit, which ripened in July; and, on being macerated in water and committed to the earth, they fprung up in twelve days.

"From the other, however, I removed all the male plants, as foon as they were old enough for me to diftinguifh them from the females: the remaining females grew very well, and prefented their long piftilla in great abundance; thefe flowers continuing a very long time, as if in expectation of their mates, while the plants in the other pots had already ripened their fruit, their piftilla having quite in a different manner faded, as foon as the males

males had discharged all their pollen. It was certainly a beautiful and truly admirable spectacle to see the unimpregnated females preserve their pistilla, so long, green, and flourishing, not permitting them to begin to fade till they had been for a very considerable time exposed in vain to the access of the male pollen. Afterwards, when these virgin plants began to decay through age, I examined all their calyces in the presence of several botanists, and found them large and flourishing, although every one of the seed buds was brown, compressed, membranaceous and dry, not exhibiting any appearance of cotyledon or pulp. Hence I conclude that the female hemp cannot produce when deprived of the male; and when it has happened, it has been owing to the pollen having been brought by the wind from some distant part.

"2d. In the month of January 1760, the antholyza cunonia flowered in a pot in my parlour, but produced no fruit, the air of the room not being sufficiently agitated to waft the pollen to the stigma: one day, about noon, seeing the stigma very moist, I plucked off one of the antheræ, by means of a fine pair of forceps,

ceps, and gently rubbed it on one of the expanded ſtigmata. The ſpike of flowers remained eight or ten days longer; when I obſerved, on gathering the branch for my herbarium, that the fruit of that flower only on which the experiment had been made had ſwelled to the ſize of a bean: I then diſſected the fruit, and diſcovered that one of the three cells contained ſeeds in conſiderable numbers, the other two being entirely withered.

"3d. Several ſpecies of momordica have frequently borne female flowers, which, although at firſt vigorous, after a ſhort time have conſtantly faded—have turned yellow, without perfecting any ſeed—till I inſtructed the gardener, as ſoon as he obſerved a female flower, to gather a male one and place it above the female. By this contrivance we are ſo certain of obtaining fruit, that we dare pledge ourſelves to make any female flower fertile that ſhall be fixed on.

"4th. I removed all the antheræ out of a flower of chelidonium corniculatum (or the ſcarlet horned poppy) upon the firſt opening of its petals, and ſtripped off all the reſt of the flowers; another day I treated another flower of the ſame plant in the ſame manner,

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but ſprinkled the piſtillum of this with the pollen borrowed from another plant of the ſame ſpecies: the reſult was, that the firſt flower produced no fruit, but the ſecond afforded very perfect ſeed; ſo that the mere removal of the antheræ from the flower is not in itſelf ſufficient to render the germen abortive."

One evening, in the month of Auguſt, Linnæus removed all the ſtamina from three flowers of the mirabilis longiflora, at the ſame time deſtroying all the reſt of the flowers that were expanded, to three; he ſprinkled theſe three flowers with the pollen of the mirabilis jalappa: the ſeed buds ſwelled, but did not ripen: another evening he performed a ſimilar experiment, only ſprinkling the flower with the pollen of the ſame ſpecies: all theſe flowers produced ripe ſeed *.

* The firſt of theſe experiments only proves, what is very obvious, that the tenderneſs of the germen requires a proper clothing for its protection; and that when it is deprived of that clothing which the ſtamina and pollen afforded, it frequently withers and decays, in the ſame manner as the embryo of oviparous animals, when deprived of the ſhell, or of the membranes it contains. The ſecond experiment only proves, that although the germen, when deprived of the ſtamina, ſometimes withers and decays, as in the firſt experiment—that this is not always the

the cafe, as in the fecond; but that it is able to arrive to a degree of maturity, by virtue of the inherent power it contains. It does not therefore appear at all neceffary, that the ftamina fhould afford any other affiftance to the germen, than as a protecting medium from the injuries to which it might otherwife be expofed: the pollen it fecretes would feem to bear fome analogy to the liquor amnii, and the ftamina themfelves to the membranes in which it is contained.

There are many facts of a fimilar kind ftated in botanical works, and related and obferved by practical Botanifts. It is a misfortune when men of veracity and character differ fo ftrongly, as they are found to do, upon plain matters of fact; but the experiments upon diœcious plants, by Tournefort, &c. &c. &c. weaken very much the force of thofe made by Linnæus; for, admitting, as it muft certainly be, that they are detailed with truth, the conclufion comes to this, that flowers with ftamina alone are barren; thofe with piftilla without ftamina are prolific, but more efpecially thofe that have ftamina and piftilla together, within one and the fame calyx: the feed that is ultimately evolved conftitutes the ovum, in which the living principle of the future vegetable in capacity refides; after it is perfected and matured, it becomes totally independent of the parent from whence it fprung.

N. B. There are many parts which I have omitted to defcribe: I did not mean to enter into a particular detail of the vegetable œconomy; I meant only to give fuch an account of the ftructure and functions of its parts as fhould be fufficient to account for the phænomena it difplayed, and to defcribe the *manner how* it fulfilled the final caufe of its exiftence.

CHAP.

CHAP. IV.

OF THE MODE OF PROPAGATION IN DIFFERENT ANIMAL SYSTEMS.

In the lower order it is regular, and more extenſive than in the higher—the mode deſcribed: in hermaphrodite animals—in fiſh—in the amphibia—in birds and in quadrupeds. Experiments ſtated to prove that corpora lutea do not conſtitute the teſt of impregnation—corpora lutea exiſt when it has not taken place—in the amphibia and fiſh ſexual intercourſe is unneceſſary—in quadrupeds fœcundation can take place by that mode alone, &c. &c. &c.

Such is the regularity which vegetables and the lower order of animals diſplay in the actions they perform, that we are neceſſarily led to conclude, that thoſe actions are governed by fixed and general principles, which they cannot either ſuppreſs or prevent. There is an appointed period of growth for the different organs in general of each, and an appointed ſeaſon for the evolution of particular organs, and when the diſpoſition for their reſpective actions begins and ends.

The revolution of the ſun, by which the

variety in the ſeaſons is produced, conſtitutes the grand agent by which the temperature of the medium is regulated and prepared, congenial to the nature of the animated frame, and its dormant power rouſed from its torpid ſtate into energy and action. The change which the vegetable ſyſtem undergoes, has been already deſcribed, until its final cauſe was attained and fructification completed. The ſame effects are equally evident in particular orders of the animal kingdom. Theſe changes are more evident in the lower than we behold them in the higher claſſes; more evident in inſects and fiſh, than in amphibia; in amphibia than in birds; in birds than in quadrupeds; and in quadrupeds than in the human ſpecies. It is probable that the human ſpecies, in its higheſt and moſt exalted ſtate of exiſtence, when unremittingly and inceſſantly employed in meditation and abſtraction, ſuffers not the ſame wants, or is impelled by the ſame calls of appetite, as animals, and eſpecially the lower orders, conſtantly feel.

Energy of mind, rightly directed, weakens the appetite in the organs of ſenſe to the total obliteration of it: on the contrary, in the lower orders of animals, where the appetite in the organs

organs of ſenſe is ſtrong, and the mind weak, the gratification of it is the end to which all their actions are finally directed: voluntary power is only exerted to co-operate with the impulſe it receives from the organs of ſenſe: in the firſt caſe, it is reaſon deſtitute of inſtinct; in the laſt, it is inſtinct deſtitute of reaſon.

It is this inſtinctive principle which conſtitutes the preſiding cauſe by which the lower orders of animals are ſolely directed: they are ſcarcely uſhered into exiſtence than they poſſeſs the power of procreation: they have no ſooner exerted this power, than, like the ephemeris of a day, they vaniſh into nought—or become perfectly torpid, until the return of the ſeaſon excites the action of their ſyſtem, and the ſame proceſſes again take place; the ſyſtem is then rouſed from its torpid ſtate, and a general evolution of the whole again enſues: but in no part is the proceſs of evolution ſo evident and ſtriking, as in the wonderful alteration which the organs of generation undergo.

The evolution which the vegetable ſyſtem ſuſtains has been already ſtated: it poſſeſſes the whole of the means within itſelf. When the propagation is the conſequence of ſeed, the organ by which it is produced is found

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to be refident for the moft part upon the fame branch, or enclofed within the fame calyx: in many vegetables the power of propagation is not merely confined to one, but extends to feveral different modes. If we proceed from vegetables to the loweft order of animals, we find, that although the mode of propagation may be limited with refpect to them, it is far fuperior to what the higher clafs poffefs: the fexes are not only particularly diftinguifhed, but there is evidently fexual intercourfe between them. The firft order of thefe animals are called *hermaphrodites*, where both fexes, male and female, are found exifting in one and the fame fyftem: the fnail, the flug, the leech, &c. belong to this clafs. Although hermaphrodite animals poffefs both fexes, it does not appear that the different fexes of the fame fyftem ever copulate together; the union of two feparate fyftems is neceffary to call forth the combined actions of the four fexual organs at one and the fame time.

Of the Organs of Generation in Fifh.

The organs of generation in fifh confift of two teftes and of two ovaria. The fyftem that

poffeffes the one, is called the male fifh; the other has received the appellation of female. If either are examined in the winter feafon during their torpid ftate, both thefe organs are found perfectly flaccid and empty: on the contrary, when examined in the fpring or fummer, when the evolution of the fyftem has taken place, thefe parts appear diftended and full, bearing a very large proportion to the fyftem at large: the teftes of the male fifh, which are diftinguifhed by the whitenefs of their colour, and the foftnefs of their texture, have received the appellation of roe, and are then full of a white fluid called femen: the female organs are called ovaria, known by the name of hard roe, and are completely full of ova.

When thefe parts have attained their fullnefs of evolution, they are expelled from each: the femen of the male unites with the ova of the female, and conception enfues, without any fexual intercourfe between both *.

* An exception fubfifts in the *whale:* the male poffeffes a *penis intrans,* the female a *cornuated uterus:* fexual intercourfe takes place between both fexes, and the offspring produced fuckles like other animals that belong to the clafs of *mammalia.*

It

It is with a view of accomplifhing this end, that fifh in general go in fhoals; that particular claffes of fifh have particular latitudes for their habitation, and particular fituations to which they refort at particular feafons; that when they fhed their fpawn, as it is called, it may immediately combine together. We all know the regular vifits which herrings, mackarel, falmon, and in fhort various other kinds of fifh pay to our coaft: the prolific power they poffefs is proved by the immenfe fhoals in which they congregate *.

If we proceed to examine thefe parts in what are called the amphibia, and even in birds, the fame enlargement is equally apparent.

The animals that belong to the amphibious clafs confift principally of the frog, the toad, the turtle, the lizard, and all of the fnake kind: there is however a fhade of difference in the individuals of each clafs; that the chain of

* When mackarel return in July and Auguft from the northward, after having fpawned, they appear much weakened, and the parts feem to be in a ftate of confiderable decompofition, as is manifefted by the fenfible properties they poffefs; the flefh is rancid and ftringy, and very fapid to the tafte.

difference may be complete from the loweſt to the higheſt; from the moſt irrational (inſtinctive) and prolific to the moſt rational and ſterile: in the lower order we find the mode more ſimple, and the means leſs complicated; in the higher we find the means more complicated, and the end more uncertain.

Strictly ſpeaking, theſe animals are not amphibia, becauſe they are indigent of air as well as the moſt perfect quadruped, although in an inferior degree: the only amphibious animal, truly ſo called, of which we have any knowledge, is named the SYREN, which has two diſtinct organs, lungs and gills, eſpecially appropriated to ſeparate air from the atmoſphere, or air from water, and is therefore capable of exiſtence in either the one or the other element.

Of the Male and Female Organs of Generation in the Frog.

The MALE FROG has a *teſtis* ſituated in the loins: in the winter ſeaſon, during the torpid ſtate of the animal, it is found to be remarkably ſmall; but as the winter departs, and the ſpring advances, a ſudden evolution of the *teſticle* evidently takes place; and if it be examined

mined in the months of March or April, it is found to have attained a confiderable magnitude: the *teftis* has an excretory duct, called *vas deferens*, which communicates with a vesicula feminalis, and finally terminates at the *anus* (there is no penis).

The female frog has a number of fmall ova attached to the loins, fimilar to the teftis of the male: the ova, like the teftis, are remarkably fmall during the autumnal and winter months; but as the winter cold departs, and the vernal warmth accedes, the ova become gradually developed, and ultimately attain a confiderable fize: there is an oviduct terminating in an uterus to which it is attached.

If thefe animals are examined in the month of March, the appearance they difplay is totally different from what they manifefted in the winter: inftead of being thin and flat, torpid and languid, they are found extremely lively and active; the male is plump and fat, the female diftended and fwelled to a confiderable fize: and finally, inftead of fubfifting in a ftate of feparation and divorce, they are found embracing each other, and confummating their union. Animals that are in this ftate are faid

to have the *œſtrum* upon them. The mode of propagation, although very ſimple, is more complicated than in fiſh: in fiſh, there is ſeparation between the ſexes, and union only between the ſemen and the ova: in the frog, there is an union between the male and female without the intervention of ſexual organs.

The male climbs on the back of the female, paſſes his arms over her ſhoulders, and adheres to the whole ſurface of her body, by entwining his extremities around, ſo that the vas deferens, which terminates at the anus, is placed exactly above the vagina: this is the condition in which they are found, and which they preſerve for a fortnight or three weeks, until the final cauſe of their union is attained: in the female, it conſiſts in the expulſion of the ova ſhe contains; in the male, the expulſion of the ſemen through the medium of the vas deferens, which becomes ſprinkled upon the ova, and this conſtitutes the mode by which fœcundation is effected.

The ova are generally depoſited in water, as the medium proper for their reception: the ovum is involved in a caſement of mucus ſimilar to the albumen ovi: it is this mucus which

which conftitutes the matter on which the living principle firft acts and organizes, until organization has been fo far perfected as to be employed in the act of affimilating things foreign to itfelf. It is a curious circumftance to behold the different and progreffive effects this living principle produces, from its exiftence in the ovum, until it is fully and finally developed in the frog.

The firft change which the ovum fuftains, after having been depofited in water, is its evolution into a fifh or tadpole: it has a tail or organ for fwimming; its fore legs begin to grow, and it then lives upon the ground: and finally, its hind legs become evolved, making up four altogether; but it then entirely lofes its tail*.

* So powerful and ftrong does the inftinct to union exift, that it is with the greateft poffible difficulty that the male can be made to feparate from the female; and if feparated, it immediately darts back, and returns to complete the office it had begun: it will fubmit to the amputation of its limbs; nay more, the very lofs of its head, and yet obftinately and falacioufly remain, until the action of the teftis, in the production of femen, is totally exhaufted: he will do more; he will remain in that condition, even after the actions of the female are fufpended, and her frame is in a ftate of decompofition, and become putrid.

The

The higher ſpecies of the individuals which belong to this claſs, are all of the *ſnake* kind; in them we find that there is a conſiderable degree of difference ſubſiſts: inſtead of fœcundation taking place without union, by means of ſexual organs, fœcundation can be produced by means of ſexual organs alone. The male has two *teſtes*, with two vaſa deferentia, which terminate not at the anus, as in the frog or toad, but in two diſtinct penes, the ſurfaces of which are covered over with numerous papillæ.

The female has two ſets of ovaries, which extend from the middle of the animal's body towards its poſterior extremity, containing an abundant quantity of ova: there are two fallopian tubes or oviducts, which receive the ova from the ovaria, and convey them to the uterus, from whence they are expelled *.

Of

* The common ſnake generally depoſits her ova upon a dunghill, where they are hatched without the neceſſity of incubation. The greateſt number of this claſs of animals are oviparous; that is to ſay, they depoſit their eggs, and the evolution of the embryo enſues out of the maternal ſyſtem. The next ſhade of difference is found to ſubſiſt in the *viper*, which ſeems to conſtitute a medium between

oviparous

Of the Generating Organs of Birds.—Of the Male.

The changes which the generating organs undergo, are almoft equally evident in birds as in the animals we have already mentioned. The male bird has two teftes fituated in the loins: in winter, the teftes of a fparrow are wafted and fhrivelled to the fmall fize of a pin's head; in fummer, they are as large as a marble: from both of the teftes there is one excretory duct that goes from each, called *vas deferens*; which, after paffing behind the kidneys, finally terminates diftinctly in two ducts which lead to two fmall penes, fituated near the anus. In the drake, the penes are not fo fmall as in the cock; there are no veficulæ feminales; but the vafa deferentia, before their termination, have two refervoirs for femen, where it is depofited prior to expulfion. Although the penes are very fmall in their flaccid ftate,

oviparous animals, ftrictly fo called, and the beginning of the viviparous. The ova burft within the uterus, and a number of young animals are confequently produced. Such is the inftinctive difpofition that this animal poffeffes to offence, that even in this condition it attempts to bite, if it be irritated by any external caufe.

ſtate, they become erect during the ſexual act, and poſſeſs power ſufficient to emit the ſemen into the ſexual organs of the female, which has received the appellation of HEN.

Of the Generating Organs of the Female, or Hen.

The female organs conſiſt of a multitude of ſmall ova, which are attached to the loins by the medium of a ſubſtance of a cellular texture. In the cold and winter they are ſo ſmall as ſcarcely to be diſtinguiſhed, and ſo numerous, that they can hardly be ſeparated. The evolution which we have beheld in vegetables, in fiſh, and in the amphibia, takes place, in a ſimilar manner, in the ova of birds alſo; and generally in the ſpring and ſummer. The ova, which are ſituated in the loins, conſiſt of the *yolk* alone: when the hen has the œſtrum upon her, theſe ſmall ova gradually enlarge, until the evolution of the yolk is completely attained: one of theſe projects backwards towards the mouth of the oviduct, which may be conſidered as analogous to the fimbriated extremity of the fallopian tube, in the higher order of animals, and the duct to the body of the

5 tube

tube itſelf: in both caſes the tubes are attached to the uterus: the uterus is ſituated between the loins and large inteſtines, and terminates near the anus.

The œſtrum which the hen feels, is alone ſufficient to excite the evolution of theſe ova, without any ſexual intercourſe whatever with the cock. When the evolution of the yolk is completely attained, one of the ova projects backward towards the mouth of the oviduct: when it has reached that ſituation it ſeparates from the membrane which connected it to the loins, and which may be truly called the ovarium *: it then paſſes into the oviduct (fallopian tube), and in its paſſage through the oviduct the ovum receives conſiderable addition: inſtead of conſiſting of the yolk alone, as it did in the ovarium, it has the whole of the white added to it by ſecretion from the oviduct. And finally, when it gets into the uterus, it obtains the addition of a ſhell, which appears to be a ſecretion from the ſurface of the uterus itſelf, produced in the ſame

* The ſeparated part of the membrane is left gagged, and may be conceived as analogous to the corpus luteum of the higher order of animals.

manner

manner as the *membrana caduca* of viviparous animals.

An egg is compofed of a fhell, fo porous in its fabric as readily to admit the paffage of air: the internal furface of this fhell is lined with a denfe membrane, of a very cellular texture: within this firm membrane there is another one involved of a more delicate nature, by which the white or albumen ovi is immediately invefted: the external membrane does not feem to be vafcular, although the internal one abounds with veffels: the former would feem to perform the office of a placenta, abforbing air through the medium of the fhell, and which meliorates the blood which is conveyed on the internal membrane, by a number of veffels: thefe veffels confift of fuch as convey red blood, and of thofe that contain blood of a purplifh appearance.

Although an egg thus organized appears to be perfect in all its parts, and which the œftrum alone in the female feems to have the power of effecting without any intercourfe whatever with the cock, it is far otherwife. It poffeffes within itfelf the power of prefervation alone, but is totally deftitute of any pow-

4 er

er of evolution: it is abſolutely neceſſary that the cock ſhould copulate with the hen, before fœcundation can be produced, and evolution enſue *.

The evolution and ſeparation which the ova undergo, of the different oviparous animals I have mentioned, are totally independent of the will; it goes on by the effect of œſtrum alone, without any ſexual intercourſe whatever: in various inſtances, where ſexual intercourſe has been purpoſely prevented, the ova have been as perfectly evolved as if ſexual intercourſe had been permitted, and have been ultimately expelled.

There ſubſiſts a conſiderable variety in the mode by which fœcundation is produced: in ſome, one egg alone is fœcundated by one ſexual act; in others, the whole multitude of ova which the ovaria contain, are fœcundated by the effect of one ſexual act alone. It is the caſe with turkeys in general: it is ſuffi-

* If eggs unfœcundated and fœcundated eggs be placed under ſimilar ſituations of heat, or expoſed to the act of incubation under the ſame hen, the reſult will be totally different: the one will become putrid, without being prolific; the other will become prolific, without becoming putrid.

cient

cient for a cock turkey to tread the hen one individual time for all the ova to be fœcundated: it is a very common practice in Norfolk, where turkeys are remarkable for their magnitude and beauty, to lend out a cock (as horse stallions are every where else); and it has been found by direct experiment, that what I have above stated is a fact.

The internal membrane seems to have the power of contracting and of forcing the white, and afterwards the yolk into the intestines of the chick: as these diminish, the animal increases, until it is sufficiently strong to peck the shell by which it is enclosed, and to emancipate itself into the air.

The Mode of Propagation in Quadrupeds.

In proportion as we ascend in the chain of animated existence, we find a considerable abatement in the effect which œstrum alone produces. The power which the female of oviparous animals possesses, of evolving the ova she contains, does not extend to animals of a higher class by that power alone: a necessity absolutely exists, that sexual union should take place for the evolution of the ova contained in the

the ovaria of the female ſyſtem. In the one, œſtrum produces a diſpoſition to unite, without a ſeparation of the ova; in the other, a total ſeparation of the ova enſues, although no ſexual union ſhould have taken place.

Being ſolicitous to ſee what effect œſtrum alone would produce, I took a female rabbit that had the œſtrum upon her, and had her fed upon oats, beans, celery, and other kinds of food that I underſtood had a ſtrong tendency to increaſe that ſtate. I had her placed before a buck, and gave directions that they ſhould be allowed to careſs each other, whilſt abſolute union was prevented. I purſued this plan for one week; and at the time that the œſtrum was at its higheſt pitch, ſhe was killed: on examining the condition of the different organs ſubſervient to the proceſs of generation, I found them very different from what they are in a common ſtate. The external membrane by which the vagina is lined, was of a black mulberry colour, ſwelled and diſtended to a conſiderable ſize, and even projecting in part beyond the external rim: on examining the uterus, I found its colour had undergone an equal alteration: it was of a deep purple,

 evidently

evidently arifing from a præternatural quantity of blood that had been determined upon it. In examining the fallopian tubes, there was a large veffel running up the middle of both, that was enlarged to a confiderable fize, and completely diftended with blood: the tubes before their termination at the fimbriæ were torquated, and diftorted in a very extraordinary manner, having alfo a ftrong periftaltic motion: after running a little way upwards they bent downwards, terminating by a fimbriated expanfion above the ovaria, the major part of which they involved and enclofed in fuch a manner as to render them invifible except in their inferior part.

There appeared to have been a confiderable determination of blood upon the ovaria, as was manifefted by the deep purplifh colour they difplayed: the ova which the ovaria contained feemed to have fuftained fome alteration alfo; they were evidently more diftinct than is ufual, refembling in fome degree the feed refident in the pericarpium of a ripe grape. Although it appeared very clear that fome action had taken place in thefe parts, there was nothing like a feparation from the capfule, as we behold

hold in the ovarium of the hen from the effect of œſtrum alone (without ſexual intercourſe).

That there is a præternatural quantity of blood propelled into the ſexual and generating organs, in conſequence of the œſtrum, is further proved by Mr. Cruickſhank. He took a female rabbit (in heat). The feeders of rabbits aſcertain this by turning up the tail, and inverting part of the vagina: its orifice and internal ſurface are then as black as ink, from the great derivation of blood to theſe parts. Mr. Cruickſhank having run the point of a double-edged diſſecting knife through the ſpinal marrow, between the atlas and dentata, ſhe inſtantly expired. He adopted this mode of deſtroying her, becauſe when the circulation ſtopped the internal part would be found, reſpecting vaſcularity, exactly as in the living ſtate. On examination he found the internal organs of generation exactly in the ſame ſtate as the external, that is, as black as ink: the ovaria had, immediately under their external ſurface, a great number of black round bloody ſpots, ſomewhat leſs than muſtard ſeed: theſe black ſpots are the calyces or cups, which he ſuppoſes ſecrete the ova: they are extremely vaſcular:

cular: the ova themſelves are tranſparent, and carry no viſible blood-veſſels: theſe calyces, on the expulſion of the ova, enlarge and become yellow, projecting above the external ſurface of the ovaria, and form *corpora lutea:* a certain mark of conception, he conceives, in all quadrupeds, and in women themſelves, whether the embryo be viſible or not.

The fallopian tubes, independent of their black colour, were twiſted like writhing worms, the periſtaltic motion ſtill remaining very vivid: the fimbriæ were alſo black, and embraced the ovaria, like fingers laying hold of any object, ſo cloſely and ſo firmly as to require ſome force, and even ſlight laceration, to diſengage them.

That the ovaria of quadrupeds in general, as alſo of the human ſpecies, are analogous to the ovaria of oviparous animals, however different they may be in their ſtructure, will be readily allowed when we reflect on the office which both are eſpecially deſtined to fulfil, and the ſimilitude in the parts which both are found to encloſe. In vegetables, and the lower order of animals, the action of the ova which the pericarpium and ovaria

ria contain, takes place by the natural and regular progreſſion of each reſpective ſyſtem. In proportion as we aſcend in the ſcale of rational beings, the power of action in thoſe parts progreſſively diminiſhes, and requires cauſes of a more active nature than what the lower orders demand for their evolution. Sexual union, therefore, although not ſo eſſential in the one, is abſolutely neceſſary in the other: the excitement which the ovaria ſuſtain during and in conſequence of that act, conſtitutes the cauſe by which alone the ova can evolve, and become ſeparated from the ovaria themſelves.

That œſtrum alone will produce an evolution of the ova, to a limited degree, without ſexual union, was proved by the experiments I have above related. That ſexual union will produce ſeparation of the ova without fœcundation, I conceive has been proved by experiments equally deciſive*. When the application of ſemen

* The experiments to which I allude were made by Dr. Haighton, the preſent ingenious teacher of phyſiology at Guy's hoſpital, on female rabbits, and which were publiſhed in the laſt volume of the Philoſophical Tranſactions. I ſhould be very ſorry to miſtate or miſquote any one. I therefore think it a juſtice I owe to this gentleman to

men to the ovaria was abſolutely prevented by a diviſion of the fallopian tube, notwithſtanding this diviſion of the tube, the veſicles which the ovaria had contained became evolved, the external tunic burſt, and the contents were diſcharged: the veſicles in which the ova were contained were conſequently left hollow, the parietes or ſides gradually thicken, and theſe thickened bodies conſtitute what anatomiſts have called *corpora lutea.* The exiſtence, therefore, of corpora lutea is a proof that the ſexual act has been ſo far perfect as to produce this action within the veſicles, and that it does take place without the application of ſemen to the ovaries in which the veſicles are contained.

That the application of ſemen to the ovaria is not the cauſe of the evolution of the ova in the veſicles, is decidedly proved, by the veſicles which the ovaria contain undergoing the ſame changes after the ſexual act, even when the obliteration of the fallopian tube of that

to ſay, that although I mean to employ the facts which he has aſcertained, the conſequences I mean to draw from them are mine, not his: whatever errors, therefore, may be attached to my inferences are not his, but mine.

ſide

fide rendered the application of femen to the ovaria utterly impoffible.

Exper. 17. by Dr. H. A full grown virgin rabbit, which had betrayed figns of being difpofed for the male, was procured—an incifion was made on the pofterior part of each flank, exactly upon the part where the tube was fituated: with the aid of a bent probe a fmall portion of the middle of the tube was drawn out, and about one-eighth of an inch cut off; the two ends were returned into their former pofition, and the wound clofed and healed. On admitting the male to her, about one month after the operation, fhe betrayed no reluctance, and became impregnated: ten days after fhe was killed and opened: the tube was fo completely obliterated as neither to allow the tranfmiffion of air or of quickfilver *; both ovaria retained their primitive plumpnefs, the veficles in *both* ovaries had burft, and their contents were difcharged. That this had taken place

* I think it neceffary to ftate, that I have myfelf feen thefe parts, which are now in Dr. Haighton's collection, and that I am convinced that the obliteration is fo complete—the extremities fo hermetically fealed—that the moft fubtle fluid could never be made to pafs.

was proved by the ſame marks that the ovaria of both ſides evidently bore, of the perfect and of the mutilated.

Exper. 11. by Dr. H.—Having procured a full grown virgin rabbit, I divided, ſays he, one of the tubes at a little diſtance from the cornu uteri: the wound ſoon healed up; and, on admitting the male to her about one month from the operation, ſhe betrayed no reluctance to the male (contrary to former experience), and became impregnated: ten days after, ſhe was killed and opened: both ovaries retained their primitive plumpneſs: there were corpora lutea in both ovaries: thoſe ſeated in the ovary of the mutilated ſide did not differ in any reſpect from the ſame bodies on the perfect ſide, *but they were unattended with fœtuſes;* whereas, on the perfect ſide *there were as many fœtuſes as corpora lutea.*

Exper. 12. Within the ſpace of a month, ſays the Doctor, I cut through the fallopian tube on one ſide, in ſix rabbits: the ſeaſon was warm, and conſequently favourable for breeding: as ſoon as they were recovered, they were admitted to the male, but out of this number two only were impregnated: of thoſe two which

which ſucceeded, one had *three corpora lutea and three fœtuſes on the perfect ſide*, *with two corpora lutea and no fœtuſes on the imperfect*: the other, which had never been impregnated before, had *two* corpora lutea and *two* fœtuſes on the perfect ſide, with *one* corpus luteum and *no* fœtus on the mutilated ſide.

Although the act of coition produces this evident alteration in the veſicles, alteration alike in both ovaria, in the mutilated ſide as well as in the perfect; it does not, however, appear that fœcundation has then taken place; for, although the ovaria retained their primitive plumpneſs, and corpora lutea were found in both of them bearing preciſely the ſame characters and appearance;—although, I ſay, there were corpora lutea in both ovaries, there were fœtuſes only in the perfect ſide, the number correſponding to the like number of corpora lutea in the ovarium; the ovarium of the mutilated ſide had corpora lutea alſo, but there were no fœtuſes whatever to be found; not even the ſlighteſt veſtiges of any.

That the exiſtence of *corpora lutea* is not an infallible teſt by which we are to decide that impregnation or fœcundation has taken place

in

in theſe animals, more than in birds, when unfœcundated eggs are ſeparated from the ovaria, is further proved from the exiſtence of a plurality of *corpora lutea* to the number of fœtuſes, when the parts have ſuſtained no mutilation.

Exper. 7. Mr. C. opened a doe rabbit the eleventh day poſt coitum: there were ſeveral *corpora lutea* in the ovaria, but two *ova* only.

Exper. 8. He opened a doe rabbit the fifteenth day after coition: there were ſeven *corpora lutea* in one ovarium, and one in the other, and yet there were only two ova in the *cornua* uteri, one on each ſide.

He opened a doe the ſeventh day: the ovaria appeared to be ſhrunk; there were ſomething like three *corpora lutea*, but not diſtinct; there were two polypi or ſolid excreſcences in the left horn of the uterus, but no ova *.

From

* It is a very curious and extraordinary circumſtance, when we reflect on the various anomalous ſubſtances that are occaſionally found involved within, and contained by, the ovaria. I myſelf have ſeen, in one ſubject, a canine tooth perfectly formed; and, in another, a quantity of hair mixed with a matter of a ſebaceous kind: and I have heard anatomiſts ſtate, that they had occaſionally ſeen bodies equally ſurpriſing and extraordinary. It would appear,

From a review of thefe facts I am led to conclude, that the exiftence of corpora lutea is a proof that the fexual act has completed what œftrum had the power of beginning alone: that is to fay, œftrum produced a flight degree of action only, as was evident in the experiment Mr. C. and myfelf made: but coition, which produces a higher degree of œftrum, is alone adequate to excite fuch an evolution within the ova, as is fufficient to induce their feparation from the capfule by which they are contained *.

pear, indeed, that the effential nature of the ovaria is very different from that of any other part; we have no example where any part undergoes, by the procefs of difeafe, fuch extraordinary changes: an ovarium, that in its healthy and natural ftate is as fmall as a fmall walnut, fhall, in confequence of a depofition of ferum within its contents, enlarge to fuch an enormous fize, as actually to contain fifteen or twenty gallons of that fluid, and even more than this quantity. I have feen, in feveral inftances, one ovarium extend as far upwards as the diaphragm, to which it was attached, filling up both fides of the abdomen, and reaching, on one fide, as far as the vertebræ.

* I am perfectly aware that in this conclufion I ftand folitary and alone: it is a conclufion in direct contradiction to thofe ingenious men who have written upon the fubject, Dr. Haighton, Mr. Cruickfhank, Baron Haller, and De Graaf.

It

It not only appears evident that corpora lutea may exiſt without fœcundation, but experiments prove that fœcundation does not take place until a conſiderable time after the ſexual act is completed. That this is a fact, is proved from hence, that if the ſexual act has been permitted to take place, and the fallopian tube of one ſide divided a ſhort time after, although corpora lutea will be found in the correſponding ovarium, there will be no fœtuſes in the cornu uteri of that ſide: on the contrary, in the perfect ſide, there will be found as many fœtuſes in that portion of the uterus as there are corpora lutea in the correſponding ovarium.

Exper. by Mr. C.—The day after a doe had received the male, he made a ſmall opening on the left ſide of the abdomen, got down upon the uterus juſt where the fallopian tube goes off, and tied the left tube cloſe to the uterus, with a view to intercept the ova: fourteen days after the operation, the animal was opened: there were ova looſe on the right ſide of the uterus, a white vaſcular belt was beginning to form, and in the middle of this, a cavity where the veſicle lay: the ovarium and uterus had gone backwards as to the proceſs, and

and there was no other appearance of conception in the uterus, no other placenta; the fallopian tube was very large, ſoft, and tender, the ovarium twice the ſize of that on the other ſide, red; and covered with extravaſated coagulated lymph; there was an hydatid on the corner of the tube containing a clear fluid, but *nothing like a fœtus.*

Exper. 14. by Dr. H. One of the tubes of a rabbit was divided half an hour poſt coitum, and the wound cloſed as before; ſhe was kept a fortnight, that I might know the reſult; but there were no marks of impregnation on either ſide.

Exper. 15. by ditto. I repeated the ſame operation on two other rabbits, on one at four, on the other at ſix hours poſt coitum; on inſpecting the parts at the end of a fortnight, the firſt was not impregnated, but the laſt was. In this there were four corpora lutea, in the right or perfect ſide, anſwering to the ſame number of features in the cornu uteri of that ſide, but on the left or imperfect ſide there were *three corpora lutea without fœtuſes.*

Exper. 16. The ſame experiment was repeated twelve hours poſt coitum, and the parts

examined on the fifteenth day: there were four corpora lutea with the ſame number of fœtuſes on the perfect ſide, three corpora lutea *with-out* fœtuſes on the imperfect.

Exper. 17. The diviſion of the tube was ſuſpended twenty-four hours, but the reſult was the ſame.

Exper. 18. The diviſion was ſuſpended in this caſe to the great length of forty-eight hours poſt coitum, with the ſame reſult alſo; there were three corpora lutea, and as many fœtuſes in the perfect ſide, and *two corpora lutea without fœtus on the divided.*

Far different are the effects we behold, if the ſexual act be permitted to take place in a perfect, inſtead of a mutilated, animal; and if a ſufficient time be allowed for conception to take place, and for the eſcape of the ova into the uterus; inſtead of corpora lutea on the *per-fect* ſide, with correſpondent fœtuſes on the uterus of that ſide; corpora lutea on the *imper-fect* ſide, and ſterility, or no fœtus on the cor-reſponding ſide of the uterus: there are cor-pora lutea in both ovaria, and *correſpondent fœtuſes in both cornua uteri.*

It is therefore neceſſary to point out, not only

only the changes which theſe different parts progreſſively undergo, but the period of time which is neceſſary for the ſeparation of the ova from the ovaria. In order to do this, I thought it proper to examine the poſition of the fimbriated extremity of the fallópian tubes in the virgin ſtate, whilſt the animal was not in heat, that I might be better able to comprehend the effect which œſtrum produces upon it, and when ſexual intercourſe had excited the œſtrum to the higheſt poſſible pitch.

The ovaria of rabbits are two in number, ſituated in the loins, one in each: the fallopian tubes, which ariſe from each of the cornua uteri, are of conſiderable length, and take a twiſted direction, eſpecially towards their ſuperior extremity: after running a little above the ovaria, they bend downwards, and terminate in a fimbriated extremity, which lies exactly upon the ſuperior part of the ovaria: their extremity appears to be all of a heap, and may be compared to an umbrella when it is not expanded: on the contrary, when the animal is hot, this part ſeems to undergo very conſiderable alteration; it progreſſively expands, ſpreading itſelf like an umbrella that is open, and

and involving within its grafp either a portion or the whole of the ovarium; they are extremely turgid with blood, efpecially if the œftrum has been upon the animal fome time.

In two hours and a half poft coitum, I found that a portion of the fimbriæ was in complete union and contact with a portion of the ovarium, perhaps a quarter part of the whole: in twelve hours and a half poft coitum, I found more than one third of each ovarium fticking and firmly adhering to a portion of the fimbriæ. In forty-eight hours poft coitum, I found the fimbriæ completely embracing not a mere portion, but the whole circumference of the ovaria: about a quarter part of the inferior portion only was left in a denuded ftate.

Dr. Haighton expreffes it thus: "In forty-eight hours poft coitum, the fimbriated extremities of the fallopian tubes were preparing to receive their contents, as appeared by having quitted their ufual pofition, and embraced the ovaria in fuch a degree, that only a fmall portion could be feen until the tubes were taken away."

Mr. Cruickfhank, fpeaking of œftrum alone, fays:

ſays: "The fallopian tubes, independent of their black colour, were twiſted like writhing worms; the periſtaltic motion ſtill remaining very vivid: the fimbriæ were alſo black, and embraced the ovaria like fingers laying hold of any object, ſo cloſely and ſo firmly, as to require ſome force, and even ſlight laceration, to diſengage them." Since œſtrum without ſexual intercourſe can produce ſuch alteration upon theſe parts not only in point of fabric, but of poſition alſo; we may conclude that the œſtrum which is produced and increaſed by ſexual intercourſe muſt augment theſe effects in a wonderful degree.

This afternoon, September 14th, 1797, I examined a doe rabbit two hours and a half after ſhe had been admitted to the male. I was very much ſurpriſed to find ſome appearances which had never been noticed, and which to me ſeem to favour the preſumption, that ſemen is actually conveyed to the ovaria. There was a veſſel running up the middle of the fallopian tube carrying red blood: a portion of the fimbriated extremity adhered completely to one ſide of the ovarium: on the portion of the fimbriæ oppoſite to the part that adhered to the ovaria, I was very much ſurpriſed to ſee

a fluid apparently contained in a veſicle, the parietes of which were ſo extremely tranſparent, that I ſhould not have diſcovered that there did ſubſiſt any ſubſtance, had it not been for the fluid I have mentioned, which appeared evidently to be ſuſpended by ſomething. I examined it with a microſcope which I had by me at the time, and ſome ſlight traces of an expanded web were apparent; on touching it with a probe it afforded no reſiſtance; but I found that the fluid it ſuſpended was not enveloped, becauſe it moved by the elevation which the membrane received. The quantity of this fluid might perhaps amount to two large drops; in colour it was white; in appearance, exactly reſembling æther; on taking it between my fingers it ſpread itſelf as æther is wont to do.

On the internal ſurface of the fimbriæ there were two circumſcribed bodies, of a pearl-like colour, of a globular form, and the ſize of a large pin's head: on preſſing them between the fingers, the external covering ſnapped, and a quantity of a very ſubtle fluid ſpirted out to a conſiderable diſtance. I do not believe that theſe were ova (although they bore the marks of being ſo more than of

any

any thing I can mention), becaufe I found they were attached to the fimbriæ, and there were no corpora lutea yet formed.

Although there were no corpora lutea, it was very evident that a confiderable degree of action had taken place in the ovaria; the vefìcles were protruding confiderably, and on cutting into the ovarium, I found different ftreaks of red blood in its internal fabric. On examining the other fide, the fluid I have defcribed exifted, although in a fmaller quantity, and the fame globular bodies alfo.

Struck with thefe appearances, I directed the rabbit-keeper to procure me a doe for this morning. I examined her at the expiration of two hours and a half poft coitum: there were the fame pearl-like fubftances prefent, attached to the internal furface of the fimbriæ*. But the fluid I difcovered yefterday was not apparent: one fide of the ovaria was enveloped by the fimbriæ, to the extent of nearly one third part of the whole; the periftaltic motion of the fallopian tubes was particularly apparent, and the veficles were confiderably advanced. I do not pretend to af-

* Dr. Haighton tells me, that he has very commonly met with the fame bodies alfo.

firm that the fluid I ſaw was ſemen, or what might rather be called the aura ſeminalis, although I believe that it was.

Mr. C. opened a female rabbit two hours after ſhe received the male: the black, bloody ſpots which he diſcovered in a former experiment, now projected much above the ſurface of the ovaria: ſome of the ruptured orifices were juſt viſible, but in many of theſe ſpots there was not the leaſt veſtige of an oriſice. While the animal was yet warm, he injected the arterial ſyſtem with ſize, coloured with vermilion; when every thing he had before ſeen, became now more diſtinct, and the black ſpots which he ſuppoſed to be a congeries of veſſels, were now proved to be ſo*.

Dr. Haighton, after having procured ſeveral virgin rabbits in a fit ſtate for impregnation, admitted one of them to the male: twelve hours after, it was killed; and on examining the ovaries, ſeveral of the veſicles evidently projected; they had loſt their tranſparency, and

* It is proper for me to obſerve, that I have repeated this experiment, and examined the ovaria at the expiration of the ſecond hour poſt coitum; but I never found the proceſs of evolution quite ſo far advanced as Mr. C. has deſcribed.

were

were become opaque and red: when punctured, a fluid of the ſame colour eſcaped, on making ſections through ſome of them: but the veſicles were not very evident. In twenty-four hours another rabbit was examined: the colour of the fluid contained in the veſicles was ſimilar to that of the laſt experiment: the veſicles projected more evidently, and their thickened parietes manifeſted the commencement of corpora lutea, which were become more apparent.

In forty-eight hours poſt coitum, the veſicles of another rabbit were in the very act of burſting, and a ſemi-tranſparent ſubſtance of a mucus-like conſiſtence was beginning to protrude from ſome of them; others were leſs advanced: ſections being made into the thickened veſicles, the formation of corpora lutea appeared to have made further advances.

In two days and twelve hours after coition, the ovaria of another rabbit were examined by him: the fœtal rudiments had eſcaped, but the cavity of the ovarian veſicles had ſuffered but little diminution. Briſtles were eaſily introduced by the ruptured orifices.

Of the proximate Caufe of Fœcundation.

From the various facts I have ftated, I think we are warranted to conclude,

1. That the act of fexual intercourfe is the immediate caufe, by the power of which the feveral organs in the male and female are made to undergo their feparate, although correfpondent changes.

2. In the male, the fpecific power of the teftes is excited, and femen in confequence produced; which femen is the immediate agent that contains the characteriftic properties of the mafculine fyftem; and is conveyed from the vagina of the female through the uterus, and received by the fallopian tubes. In the female, the increafed vafcularity not only of the vagina, but of the uterus and tubes, proves the capacity thefe parts poffefs of fympathizing with the fexual organ of the male.

3. That the fallopian tubes conftitute the media of communication to convey the femen from the uterus to the ovaria, which they do by means of the periftaltic power, which thefe tubes fo eminently poffefs, that in proportion as the evolution which the ova fuftain (in the vefícles

vesicles of the ovaria,) a correspondent change takes place in the fimbriæ; that the fimbriæ progressively grasp the ovaria, and immediately apply the semen to the ova: that by the union of both, fœcundation takes place, and which constitutes the *proximate cause* of animal impregnation.

In order to put so difficult a subject in as clear a point of view as I am capable, I shall state it in different words: viz. The different changes which the several parts in the male and female undergo, all tend to one end, namely, the immediate contact of the fimbriated extremity of the fallopian tubes to the surface of the ovaria; that an union might take place between the fluid which the fimbriæ convey, and the ova (of a mucus-like appearance) which the vesicles discharge; that it is the semen which receives the characteristic properties of the male; and the fallopian tubes, the medium by which it is conveyed, in the same manner as the fluid which the vesicles discharge, contain and convey the characteristic properties of the female; that the fimbriated extremity of the fallopian tubes is the immediate seat where this effect takes place; that the union of both constitutes *conception*, or the

immediate reception of a *living principle*, in which the ſource and power of action eſſentially reſides, and which participates the nature of both parents, by the combined action of whom it was produced.

That fœcundation takes place either at the extremity of the fallopian tube, or in the very calyx itſelf, which is formed by the action of the veſicle after the ſexual act, is not only very probable, from the appearance which the parts diſplay, but the probability is greatly increaſed from the adventitious circumſtances which ſometimes happen, when a fœtus is found reſident either in the ovarium, or attached to the fimbriæ, or lodged within the body of the tube itſelf; or, what perhaps leſs rarely happens, when the embryo drops from either of thoſe ſituations, and becomes attached to ſome part of the abdominal cavity: theſe are called extra-uterine caſes in general, each caſe receiving the particular denomination from the particular part in which it is found, as abdominal, ovarial, fimbrial, and fallopial *.

As

* The ſterility which uniformly attends the higher order of animals when there is no ſexual intercourſe, is a demonſtrative proof that ſexual intercourſe conſtitutes one of the neceſſary means for the propagation of the ſpecies.

Although

As Mr. Cruickſhank and Dr. Haighton have ſo recently inveſtigated this ſubject, I think it an act of juſtice I owe them, to ſtate their opinions alſo, although I differ in part from them both.

Dr. HAIGHTON concludes by ſaying, "that when we take a reflected ſurvey of theſe ſucceſſive operations, I think it muſt appear, on tracing Nature's ſteps through the different ſtages of this work, *that they are the product of that law in the conſtitution which is called* SYMPATHY, *or conſent of parts.*

Although we are certain of the fact, and poſſeſs a knowledge of the inſtruments which are employed, we are totally ignorant of the manner by which conception is effected; it is impoſſible for immaterial principles to become cogniſable to organs of ſenſe. Organs of ſenſe, and the ſenſible inſtruments they employ, are too groſs, and therefore unapt and unfit to attain a knowledge of the refined exiſtence of Beings ſpiritual and immaterial; it is the province of Intellect alone pure and unmixed, by which ſuch Beings can be contemplated; and the only power by which theſe efficient and primary cauſes can be underſtood: to our organs, as the ſecondary or inſtrumental cauſes, the province belongs to behold ſenſible effects alone, or the various phænomena produced; it is in this purſuit that Phyſiologiſts and Chemiſts toil with ſuch ardour and ſucceſs, and by which we have been enabled to aſcertain the different parts concerned in the act of conception, and to notice the different changes and alterations they undergo.

That

That the femen firft ftimulates the vagina, os uteri, cavity of the uterus, or all of them.

By Sympathy the ovarian veficles enlarge, project and burft.

By Sympathy the tubes incline to the ovaria, and, having embraced them, convey the rudiments of the fœtus into the uterus.

By Sympathy the uterus makes the neceffary preparation for perfecting the formation and growth of the fœtus, and

By Sympathy the breafts furnifh milk for its fupport after birth.

And finally, he exprefsly concludes, that neither femen in a palpable form, or as aura feminalis, is ever applied to the ovaria.

Mr. CRUIKSHANK does not enter into the proximate caufe of conception: he confines himfelf rather to the procefs of evolution after conception has been effected; he makes however the following GENERAL CONCLUSIONS:

1. The ovum is formed in, and comes out of the ovarium after conception.

2. It paffes down the fallopian tube, and is fome days in coming through it.

3. It is fometimes detained in the fallopian tube, and prevented from getting into the uterus.

4. De Graaf faw one ovum only in the fallopian

pian tube; "in oviductus dextri medio *unum!*" I ſaw thirteen in one inſtance, five in another, and three in another; in all twenty-one.

5. The ovum comes into the uterus on the fourth day.

6. De Graaf did not ſee the fœtus till the tenth day. I ſaw it on the eighth.

7. Theſe experiments explain what is ſeen in the human female.

N. B. Theſe two papers are publiſhed in the Philoſophical Tranſactions for the preſent year 1797.

Conception, I conclude, is not an effect produced from the energy of a power reſident in one ſyſtem, or in one ſex; but in two ſyſtems of different ſexes; not in the male or female individually, but from the united action of both male and female together.

If it were an effect of which the female alone were the cauſe, and the offspring produced had a prior ſubſiſtence in the maternal conſtitution, ſexual intercourſe would be unneceſſary, ſince the maternal ſyſtem alone would be efficient of the end; like vegetables in the production of ſeed, of bulbs, of buds, and

and of ſlips: if the rudiments of the fœtus had a previous ſubſiſtence in the female frame, although ſexual union might be a neceſſary means to excite the evolution of its parts, ſexual union could effect no change whatever in the ſpecific nature of the offspring itſelf; it is probable, that it would bear a reſemblance to the maternal ſyſtem only; but it certainly could never participate any of the diſtinguiſhing features by which the paternal conſtitution is characteriſed. And finally, if the paternal conſtitution poſſeſſed the means excluſively and alone, the maternal ſyſtem might be able to ſupply it with nouriſhment and ſupport, but could never impart any of her own features to the offspring produced.

That this is not the caſe, will be apparent, if we reflect on the particular nature of the offspring produced from parents of different colour. From a white man and a black woman, the child produced is neither white nor black, but a medium between both; namely, a mulatto: and if we were to trace the various ſhades of difference that exiſt in conſequence of the mixture of different caſts with each other, we ſhould then ſee, that both parents

impart to the offspring produced an union of colour and of features alſo; and that parents of the ſame colour propagate particular marks which they poſſeſſed, and which the offspring inherits: It was theſe that Gay always looked for:

"Where are the father's mouth and noſe,
"The mother's eyes as black as ſloes?"

This co-operation of power is abundantly proved in all hybrid (baſtard) breeds, in conſequence of the union of different ſpecies of animals with each other: of an horſe and an aſs; neither an horſe nor an aſs is produced, but a medium between both, that is, a mule.

It is equally proved by the offspring produced in conſequence of the union with each other of different ſpecies of the canine tribe, of the feline, and, in ſhort, of almoſt every other that exiſts. On the contrary, the nations, as the Chineſe, which refuſe all intercourſe with aliens, have a national appearance in them very ſtrongly marked; it is the ſame with particular tribes of the Jews that marry with each other; and more eſpecially in particular families, when very near relations are allowed to marry, as amongſt the Portugueſe:

and

and finally, it is the caufe why brothers and fifters that marry firft coufins, produce children that fo frequently bear a very ftrong refemblance to each other. The neceffity of a difference of fex in animals for the propagation of the fpecies, would feem to point out the propriety, that fexual alliances between families fhould not be too clofe; and it were perhaps better for intermarriages in general, between near branches of the fame family, to be avoided as much as poffible.

It is owing to the conftant inclination which the lower order of animals inherently and inftinctively poffefs, to copulate with their own fpecies, that the breed continues alike; and that we behold an uniformity and famenefs of character in the different individuals of which a clafs is compofed;—that vegetables always refemble the parent ftock, unlefs indeed the pollen fhould have been of a fpecies different from the fyftem which contained the piftillum: the feed fœcundated in confequence does not produce a natural, but a baftard offspring*.

Of

* After the ovum has efcaped from the veficles, by which

Of the Paſſage of the Embryo from the Fimbriæ through the Fallopian Tube into the Uterus *.

Exper. 25. Mr. C. opened a rabbit at two days and a half after the coitus. Ovaria impregnated, but found no ova in the tubes, nor orifices in the corpora lutea.

Exper. 27. Opened again another, at two days and a half; and though there were a great

which it is contained in the ovarium, a hollow or cleft is left, the parietes of which gradually thicken; and it is theſe calyces, or cups, that conſtitute corpora lutea; but which have nothing more to do with the ova after they have eſcaped, than the ſocket of a tooth has to do with a tooth after it has been extracted and removed from the ſocket or calyx in which it reſided before.

* Mr. Cruickſhank has inveſtigated, with great diligence, the progreſs which the embryo ſuſtains in the courſe of its evolution. I ſhall make uſe of the experiments which he has detailed, not only becauſe they were continued farther than mine, but becauſe I am perſuaded, from what I have beheld, that they are accurate. He will however pardon me for changing the ſtate in which they are now collected (ariſing, no doubt, from the hurry in which I underſtand they were written for the Royal Society), and arranging them with ſymmetry and order, as they ought to have been.

many

many corpora lutea, I could not diſcover any ova; they were probably too ſmall to be perceived; for, on the third day complete, ſome of the ova were not perceptible, till they were put into a fluid, and reviewed in a microſcope.

Exper. 28. Opened one the third day all but two hours; found ſix ova in one fallopian tube, and ſeven in the other; which correſponded exactly to the number of corpora lutea in each ovarium; the ova had three membranes as before. The circles in the cicatricula in the hen's egg are perhaps ſimilar to theſe; the ova ſeem to enlarge in their way down the tubes, as a pea ſwells in the ground before it begins to take root; even in the uterus, for two days they are either looſe, and unconnected by veſſels, or the veſſels are ſo ſmall as not to be diſcovered by the microſcope; the corpora lutea were flatter on the head than I had ever ſeen them before.

Exper. 26. Opened one, third day complete; found about ſix or ſeven ova in the fallopian tubes, near their ends, or about an inch within the tubes, on the ſide next the uterus: in the microſcope, the ovum appeared as having three coats,

coats, the middle one perhaps become allantois or membrane.

Exper. 24. I opened another at three days and a half: ovaria had the appearance as if the ova had not yet gone out; however, many of them were found in the uterus, and many in the tube; I got about ſix, others were loſt from the great difficulty in ſlitting up the fallopian tubes, without bruiſing the ova with the finger, or with the point of ſciſſars: there were eight or nine corpora lutea in one ovarium, and two only in the other; on the ſide of the two, I found *one* ovum only, but twice as large as thoſe on the other ſide. I obſerved that the redneſs of the uterus depended on not loſing much of the animal's blood; for when they had been ſo killed, that much blood was loſt, the fallopian tubes, at leaſt, and ovaria, were always pale *.

It

* Whilſt I was repeating ſome of theſe experiments myſelf, I found alſo the ſudden effect that the action of fear had upon theſe parts: in one rabbit in particular that had the œſtrum upon her, and which I had killed at the expiration of two hours after having received the male, although her vagina was then of the uſual mulberry colour, by ſome accident the rabbit-keeper let her legs eſcape, ſhe ſtruggled conſiderably, and appeared frightened. Wiſh-

It would however ſeem, that there does ſubſiſt ſome degree of variety in the time which is neceſſary, not only for the evolution of the ovum in the ovarium, but in the paſſage alſo of the ovum through the fallopian tube into the uterus. The difference, it is probable, proceeds either from the difference in the activity of theſe parts, ariſing from the degree of œſtrum, or from the effect which repeated acts of fœcundation may have produced.

Exper. 3. Mr. C. opened a female rabbit the third day after impregnation; that ſhe was impregnated he could have no doubt, for he never knew impregnation fail if the female was hot, and the male had not been previouſly exhauſted. (Beſides, he ſays, the corpora lutea in the ovaria fully proved it.) Though appearances were the ſame as the laſt, only the corpora lutea were larger; but though he examined the fallopian tubes in the ſunſhine, and with great care, he could not then find any

ing to ſee what effect it had produced on the ſexual part, I found that the vagina had undergone nearly the ſame change as we behold in the cheeks, when they loſe their florid colour, and become pallid; the vagina had loſt its mulberry colour, and become red.

ova

ova neither in them, nor in the horns of the uterus.

Although the difference of activity is found to fubfift both in the ovaria and fallopian tubes, it appears, when once the ovum is conveyed into the uterus, that neither the ovaria nor fallopian tubes have any fhare whatever in the development of the ovum, to its perfect evolution into a fœtus; fo that the organs of generation perform an office totally different from thofe fubfervient to the growth and refidence of the fœtus.

Dr. Haighton divided the tubes of two rabbits, one of which had received the male two days twelve hours, the other two days and eighteen hours: the examination of thefe parts at the ufual time proved, that the action of thefe parts fuffers no interruption by a divifion of the tube, made after the rudiments of the fœtus have been conveyed into the uterus; *for there were corpora lutea in both ovaria, and fœtufes in both cornua uteri.*

Thefe experiments certainly go to prove what I have inferred, not only a difference in the time neceffary for the evolution of the ovum from the veficle, but for its paffage in-

to the uterus; they prove that it is even quicker than what Mr. Cruickſhank was able to diſcover: but they by no means go to overturn the hypotheſis, "which ſuppoſes that the effuſion of ſemen either on the ovarium or fallopian tubes, either in a ſenſible form, or in that of an aura ſeminalis, is eſſential to impregnation."

Exper. 20. by Mr. C. Opened another rabbit at the end of the third day, or rather beginning of the fourth; the ovaria were dark brown, the fallopian tubes and uterus almoſt black, from the great quantity of blood derived to them at this time. I opened this uterus on the upper edge and in the body, ſo that the parts all remained turgid; the ſpermatics and hypergaſtrics, not cut through; the corpora lutea were very vaſcular, an artery running acroſs ramified from both ſides, but particularly ſpent itſelf in the centre: the upper part of the corpus luteum, or centre, was a little concave, like the head of a turned ſmall pock, but no evident foramen. By drawing a probe gently over the fallopian tube on the left ſide, before it was opened more than an inch on the ſide next the uterus, I preſſed out ſeveral ova,

which feemed to come from about its middle, as I began the preffure there, and the ova did not appear till the very laft; the amnion made a centre fpot, and appeared fmall compared to the chorion; no ova in the uterus.

Of the Evolution of the Fœtus in Utero.

Exper. 24. Opened another at three days and a half: ovaria had the appearance as if the ova had not yet gone out; however, many of them were found in the uterus, and many in the tubes: I got about fix, and others were loft from the great difficulty in flitting up the fallopian tube; there were eight or nine corpora lutea in one ovarium, and two only in the other.

Exper. 19. Opened one in the evening of the fourth day: the ova were not much dif-perfed through the uterus, and all accumulated about the orifices of the tubes; the amnion was likewife clofer to the chorion.

Exper. 15. Opened a doe the fifth day, found the ova loofe upon the uterus to the number of fix; even thefe had a leffer coat on the infide correfponding to the amnion (none in the tubes).

Exper. 15. Opened a doe the fifth day after coition: found the ova loofe on the uterus to the number of fix: thefe had a leffer coat in the infide correfponding to the amnion.

Exper. 1. Opened a doe the fixth day complete; found the ova loofe in the uterus, as defcribed by De Graaf, and correfponding nearly to the corpora lutea, fix being in one horn, and four in the other: the ova were tranfparent and of different fizes: they were double, and contained each an external veficle; there was a fpot on one fide in moft of them, and which I conceived to be the intended point of adherence between them and the uterus; the internal veficle was not equal in proportion to the external, but in fome larger, in others lefs. I even fufpect I faw fomething of the fœtus: fome of the ova were fcattered in the uterus, juft where one of thefe veficles had become ftationary, a white vafcular belt was beginning to form, and in the middle of this a cavity where the vefìcle lay; the inner membrane I take to be amnion, the outer chorion.

Exper. 21. Opened a rabbit at fix days and a half: ova in the horns of the uterus were

juft

juſt begun to fix, but did not adhere by veſicles; they were very much enlarged, compared with the ſixth, and the ſide of the uterus had a round rough ſpot in it, now very conſpicuous: the chorion and amnion were almoſt in contact with one another; they were eaſily turned out of the uterus, which embraced them every where looſely *.

Exper. 12. Opened a doe the ſeventh day after coition; ova all fixed and adhering to the uterus, even making a ſenſible ſwell in form of belts at different parts; the amnion appeared in ſome nearer the chorion than in others; the liquor between amnion and chorion was very gelatinous, in many others leſs ſo. Saw nothing of fœtus.

Exper. 13. Opened a doe eight days after coition: there were about ten or eleven ova; fœtus diſtinct in almoſt every one, but not without the application of diſtilled vinegar for two or three minutes, and afterwards im-

* The corpora lutea now increaſed exceedingly in vaſcularity, and nouriſhed by a large veſſel running a-croſs the tubes, remarkably pale, as having done their duty; the graniform appearance on the uterus, externally, not obſervable, as in the laſt.

merſed in proof ſpirit: in ſome I found the brain, ſpinal marrow and vertebræ forming two columns at ſome diſtance; they afterwards gradually approached; for it was in one of the leaſt forward that this was moſt evident.

Exper. 29. Opened another at eight days and a half; every thing more diſtinct and more advanced than on the eighth day; the heart now viſible, and reſembling much the appearance of the incubated egg in the 48th hour. There were *ſeven* corpora lutea in the right ovarium, and but *four* ova in the right horn of the uterus; there were alſo *three* in the left ovarium, though but *two* ova in the left horn.

Exper. 6. Opened another, ninth day: fœtus contained within its amnion in another fluid, between chorion and amnion, which are now at a conſiderable diſtance; the fluid jellies in proof ſpirit *.

Exper. 17. Opened a doe the eleventh day after coitus: ova very little larger than the

* Some corpora lutea have cavities, others none, nor the leaſt appearance of orifices: the corpora lutea keep increaſing as the fœtus increaſes, are of a ſand red colour, and very vaſcular.

laſt,

laſt, nor the fœtus : there were but two ova, though ſeveral corpora lutea ; ſome pellucid hydatids appeared hanging on the outſides of the fallopian tubes ; could theſe be ova which had miſſed the paſſage* ? They were vaſcular—the heart of the fœtus was full of blood, the umbilical veſſels very diſtinct, but no chord as yet—contrary to De Graaf.

Exper. 8. Opened a doe the fourteenth day : ſeven corpora lutea in one ovarium, and one in the other : only two ova in the horns of the uterus, one in each ; that in the horn next one of the ovaries, with one corpus luteum, was blighted, and the fœtus inviſible even with diſtilled vinegar ; in the other it was increaſed proportionable to the time ; the umbilical chord now for the firſt time diſtinct, and the tail detached from the under ſurface of the uterus ; there was ſomething unintelligible about the head ; it was bifid on the ſide next the mouth, with a hole in each extremity ; the inteſtines were now apparent, at leaſt the rectum, as were the lower extremities.

Exper. 24. Opened a doe twenty-firſt day

* It is probable that theſe pellucid hydatids were in kind the ſame as the pearl-like bodies I have deſcribed.

after

after coitus: five veſſels were ſeen going out of the navel in one of the fœtuſes, beſides the urachus; the omphalo-meſenteric artery was very diſtinct, and divided into two, as it came to the meſentery; could not ſee the urachus or allantois well, nor the membrane to which the omphalo-meſenteric artery goes. Mr. C. does not purſue the enquiry any farther."

The evolution of the fœtuſes progreſſively goes on for ten days longer, making up 31 days altogether; when the period of geſtation being completed, and the containing power of the uterus exhauſted, the muſcular fibres of which it is compoſed contract, and overcome the reſiſtance of the uterine contents; the whole, therefore, is expelled, and the uterus progreſſively diminiſhes, until it nearly attains the ſize of its unimpregnated ſtate.

CHAP.

CHAP. V.

OF THE MODE OF GENERATION OF THE KANGAROO *.

The ſexual organs apparently the ſame as thoſe of other quadrupeds—the relation which they bear in the female to the organs of generation very different—the difference pointed out—fœcundation takes place in the uterus, where the embryo at firſt ſubſiſts, like an oviparous animal—it is from thence expelled, and received into the falſe belly, in which nipples exiſt, through which it receives nouriſhment, living as a viviparous animal.

THE organs of generation in both ſexes reſemble in their general characters thoſe of viviparous quadrupeds. The male has a penis intrans of conſiderable length : towards the end of the glans it gradually tapers, and terminates

* In the ſecond part of the Philoſophical Tranſactions, for the year 1795, there is an account given by Mr. Home, of the mode of generation of the animal called kangaroo, a native of New South Wales, and belonging to the opoſſum claſs. The preciſion with which the ſubject has been inveſtigated is a proof of Mr. Home's zeal, and of the anatomical knowledge he poſſeſſes ; and the fact itſelf which he has aſcertained, muſt be conſidered as a very valuable addition to thoſe who are endeavouring to trace the different links that ſubſiſt in the great chain of animated exiſtence.

terminates in a point. I ſhall paſs over the deſcription of thoſe parts of the female that are not particularly characteriſed from thoſe of other quadrupeds: the vagina is about an inch and a half in length, beyond which it divides into two ſeparate canals, and on the ridge which lies between them the meatus urinarius opens, leading to the urinary bladder: theſe two canals are extremely narrow, for a quarter of an inch in length; they then bend towards each other, terminating laterally in the two angles of the fundus uteri, of which they appear to be an uniform continuation: the uterus, which is thin and membranous, is in ſhape infundibular, and ſituated between theſe two canals: it gradually diminiſhes in breadth from the fundus towards the cervix, and terminates by the meatus urinarius; and in its virgin ſtate it is impervious. One and the ſame membrane is continued over the inner ſurface of the uterus and lateral canals; this membrane is thrown into ſeveral folds, forming various projecting ridges, one of which extends the whole length of the uterus, and as it forms a middle line it divides the uterus into two equal parts: the

ovaria and fimbriæ in appearance and ſituation reſemble thoſe of other quadrupeds; the fallopian tubes, before they reach the uterus, dilate conſiderably, forming an oval cavity: the coats are here very thick, and extremely vaſcular; the tubes again contract, and paſs perpendicularly through the coats of the uterus at its fundus, and terminate in two projecting orifices, one on each ſide of the ridge, formed by the fold of the internal membrane.

From the peculiarity in the conſtruction of the female organs of the kangaroo, ſays Mr. Home, it is very evident that they muſt very materially differ from other quadrupeds in their mode of generation. In other quadrupeds the influence of the ſemen is aſcertained to have reached the fallopian tube, by well-atteſted caſes of the fœtus never arriving at the uterus: in this animal ſuch an effect is rendered difficult, and not very probable: the ſemen of the male paſſes in a circuitous way through the lateral canals to the cavity of the uterus, and, from the ſtructure of the parts, can neither enter the fallopian tubes, nor readily return to the vagina; it is, therefore, more rational to ſuppoſe that impregnation takes

takes place in the ſame way as in the detached fœtuſes of other animals.

The embryo, in its paſſage from the ovarium along the fallopian tube, will be inveloped in the jelly formed in the oval enlargement or ſwell of the tube, and in this ſtate depoſited in the uterus, where it will come in contact with the ſemen of the male, ſimilar to thoſe animals whoſe fœtuſes are detached when the ſemen is retained in the lower part of the oviduct, and comes in contact with the egg when completely formed.

It would therefore ſeem that the mode of generation in the kangaroo forms a connecting medium between that of oviparous and viviparous animals *.

In

* If the anatomical deſcription of theſe parts, which Mr. Home has given, be correct, and there is no reaſon whatever to ſuſpect otherwiſe, it proves, in a very decided manner, that the exiſtence of a corpus luteum is not an infallible teſt of impregnation; for, in this caſe, the ovum ſeparates from the ovarian veſicle, leaving a corpus luteum perfectly formed; but the ovum does not become fœcundated until it has reached the uterus itſelf, and come in immediate contact with the male ſemen. The ſame effects are perpetually taking place from oviparous animals, ſtrictly ſo called, when unfœcundated eggs drop from

In the impregnated ſtate a corpus luteum is diſtinctly to be ſeen in one of the ovaria; the uterus and two lateral canals have their cavities much increaſed; the communication between theſe canals and vagina is completely cut off, by the conſtricted parts cloſe to the vagina being filled with a thick inſpiſſated mucus; in this ſtate of the parts there is an orifice to be ſeen cloſe to the meatus urinarius large enough to admit a hog's briſtle, leading directly into the uterus, when in the virgin ſtate no ſuch paſſage could be obſerved.

The uterus and lateral canals are uniformly diſtended with an animal jelly, ſomewhat reſembling the white of an egg; it is of a blueiſh white colour, in conſiſtence like half-melted glue, and ſo extremely adheſive as to be with difficulty waſhed off from the fingers; it is within this ſubſtance that the embryo is en-

from their attachment with the ovarium, and the ragged extremity of the ovarium, by which the peduncle of the egg was attached, is exactly analogous to the corpus luteum of the higher order of animals; not in colour, it is true, but in that which is more eſſential and characteriſtic, analogous in point of uſe, and the ſubſtance which it contained is deſtined to anſwer exactly the ſame purpoſe.

veloped

veloped at firft, without any other attachment to the maternal fyftem.

Mr. Home detected in the cavity of the uterus an organized fubftance, enveloped in the jelly, and which proved to be a fœtus; and Mr. Confidan, who was feven years an Affiftant Surgeon to the General Hofpital in New South Wales, faw the uterus of the kangaroo in its enlarged ftate three different times; and, in one inftance, he found the fœtus fufficiently advanced to be detected.

Befides the uterus, the female kangaroo has two mammæ, and each of them has two nipples; they are not placed upon the abdominal mufcles as in moft quadrupeds, but are fituated between two moveable bones connected with the os pubis, peculiar to this tribe of animals; they are covered over anteriorly by the lining of a falfe belly, with which this animal is fupplied, and it is in this cavity into which the nipples project: this covering is fimilar to the external fkin, having a cuticle and fhort hair thinly fcattered over its furface, except at the root, where there are tufts of fome length, one at the bafis of each: this falfe belly is moved by the actions of particular

mufcles

muſcles attached to particular bones, which Mr. Home has deſcribed, the young kangaroo paſſes from the uterus into the vagina, and is expelled from thence. Such, however, is the wonderful conſtruction of this animal, that the falſe belly has muſcles to bring its mouth as near as poſſible to the opening of the vulva; and the vulva itſelf has an unuſual projection. The particular fabric of the ſurrounding parts all conſpire to throw the external orifice of the vagina, ſo as to project more directly over the mouth of the falſe belly by which the fœtus is received, and where it is depoſited.

The ſize of the fœtus at the time it leaves the uterus, is not aſcertained; but it has been found in one inſtance attached to the nipple, when leſs than one inch in length, and twenty-one grains in weight: its fore paws were well formed, and double the length of the hinder ones: in another caſe it weighed thirty-one grains, and was one inch one-fourth in length from a mother weighing 156lbs.

The fœtus at this period has no navel-ſtring, nor any appearance of ever having had one: it could not then be ſaid to be perfectly formed, but an increaſed evolution had

 evidently

evidently taken place in the parts that were deſtined to lay hold of the nipple, more than in any of the reſt: the mouth was a round hole, juſt large enough to receive the point of the nipple which was contained in the falſe belly. The two fore paws, when compared with the reſt of the body, were large and ſtrong, and the little claws extremely diſtinct; while the hind paws, which were afterwards to be ſo large, were both ſhorter and ſmaller than the fore ones.

When the fœtus firſt adheres to the nipple, the face appears to be wanting, except the round hole to receive it: and as the jaws and lips grow, they cover a greater length of the nipple, giving the mouth a better hold of it: the upper ſurface of the tongue, as the organ grows, is concave, adapting it to the nipple which lies upon it.

From this beautiful mode of conſtruction, it evidently appears that this animal forms a connecting medium between oviparous and viviparous animals, exiſting in an oviparous ſtate whilſt ſubſiſting on the animal mucus in the uterus, but forming perhaps the firſt and moſt perfect ſpecies of the mammalia claſs, when exiſting in the falſe belly. It then ſits

on

on its pelvis, is poifed by the hind legs, fticks to the mammæ by its fore paws and face, and is attached by the mouth to the nipple, from whence it obtains nourifhment for its evolution and fupport. The female has never been known to have more than one young at a time. The young one after it is excluded from the falfe belly, and another is depofited in it, continues to put in its head and fuck for a month or two; and it feems to be about nine months old before it ceafes fucking altogether. One of the females now in Richmond Park had a young one in the falfe belly, when only about a year and a half old. Although the young one remains in the falfe belly, or goes into it occafionally, and fucks the mother a long time after it appears capable of procuring its own food; if the mother is clofely purfued, in attending to her own fafety, fhe then forces the young out of the falfe belly, provided it be arrived at a fufficient age to be covered with hair. The kangaroo, therefore, would feem to form a connecting medium between oviparous and viviparous animals, not only in the mode of generation, but in the mode with which it nourifhes its

 offspring;

offspring; between thofe that are nourifhed without any connection whatever with the uterus, and thofe that are attached to it *.

* From what I have ftated, it evidently appears that, in the arrangement I have formed, this account ought to have been introduced immediately after the oviparous clafs. I however thought it better to defcribe it in this place, that its œconomy might be better underftood; becaufe, partaking, as it does, in fome degree, of both the oviparous and viviparous animal, it of courfe is more complicated than either of them.

CHAP.

CHAP. VI.

ON THE PROXIMATE CAUSE OF ŒSTRUM.

Arifes from a fenfe of want in the generating organs—never begins until evolved—always prefent at particular feafons after their evolution—exifts in thofe fyftems that have generative organs, but are deftitute of fexual, in a more powerful degree than in thofe fyftems that poffefs both.

SUCH is the definite and unerring nature of the inftinctive principle, that its energy is never exerted until the organs are properly developed; but when the evolution is complete, fo ftrong is the predifpofition they poffefs to action, that the action itfelf enfues, without any rational power in the animal by which it can be counteracted or reftrained: it is this fenfation of want which the organs of fenfe feel, that may, as I faid before, be truly called inftinctive, and which conftitutes the impelling motive for the actions they perform.

Animals therefore are furious and mad when excited by hunger or thirft; or when

the ſexual organs have the diſpoſition to ſexual intercourſe, and the objects of ſexual union are abſent. The male has never the inſtinct to copulate with the female, until the organs are able to perform in the beſt poſſible manner the end for which they were deſigned: it is the ſame with the female: the neceſſity therefore reciprocates in both ſexes; and when the reſpective organs are ſo perfect, the means ſo efficient to the accompliſhment of the end,—conception is the natural conſequence.

It may therefore be laid down as a law applicable to animals in general, that the diſpoſition to ſexual intercourſe in them is the reſult of neceſſity, and that the neceſſity immediately begins as ſoon as the organs are properly evolved, and a fit aptitude is preſent in the medium by which they are ſurrounded: there are, therefore, particular climates deſtined for the habitation of particular animals and vegetables, and particular ſeaſons when the evolution of the generating organs enſues.

In the higheſt order of brutes, the ſame inſtinctive motive ſeems to exiſt, although

perhaps

perhaps in an abated degree, and is apparently the effect of one and the fame caufe. Animals of this rank have particular feafons when the fexual organs are excited to action, and when the œftrum is in full force.

The exiftence of œftrum in the male is proved by the anxiety he evidently feels; in the female it is manifefted by her lamentations and cries, and by the alteration which the fexual organs undergo *.

In the higheft clafs of animals, fuch as bitches, elephants and monkeys, where there is a diminution of inftinct, and a dawn of reafon, although the act of fexual intercourfe is a matter of neceffity, there feems to be fome degree of choice alfo. To prevent therefore the energy of this motive from being exerted before the organs are prepared and fitted to accomplifh the refpective actions, we find that thefe organs are not evolved until the fyftem in general is complete; the period of which

* This is generally the teft to which the male appeals, and the olfactory organ is the inftrument which he employs, by which he decides whether the female has or has not the œftrum upon her. If a dog who is in heat be placed amongft twenty bitches, he will be able to afcertain the fact at once.

is known by the uterine discharge they sustain: after this uterine discharge has ceased, the disposition to sexual intercourse progressively departs, and the power of conception is either suspended or finally terminated.

Of the Proximate Cause of Œstrum.

We may therefore conclude, that the proximate cause of œstrum is the consequence of the evolution which the generating organs have undergone, and that it is in them where it has its seat. The organs of generation, strictly so called, are the *testes* in the *male*, and *ovaria* in the *female*. In the lowest order of animals, the evolution takes place by an aptitude in the medium alone—In fish, by an aptitude in the medium, and the company of the male and female without sexual intercourse.—In the amphibia, there is for the most part an union between both systems, without the intervention of sexual organs.—In quadrupeds, a necessity exists, that the œstrum should be excited by an increased action in the sexual organs, through the medium of sexual intercourse. Sexual intercourse is only a further means which the higher order of animals possess and require,

require, to excite the actions of their generating organs, and constitutes a proof of the dormant power of those organs, when compared to those systems where the effect takes place by an inherent power of their own, without the subsistence of any such necessity.

That it is in the generating organs where œstrum absolutely resides, and not in the sexual, (in the male called *penis*, in the female *vagina*), is proved by the violence of œstrum in those systems that possess generating organs alone, but are destitute of sexual; namely, fish, and the amphibia. It is farther proved by the apathy that exists in those who have lost their generating organs, although the sexual organs are permitted to remain: it does not seem to be apathy simply, but direct aversion that takes place, as is evinced by geldings when they are teased by mares that have the œstrum upon them.

In the human species, the extirpation of the generating organs in the male, and which is called castration, not only destroys the power to procreation, but the desire to sexual intercourse also. On the contrary, the loss of either a part, or the whole, of the penis, does not in any

any degree whatever abate the defire to fexual intercourfe, although the neceffary inftrument for procreation may have been deftroyed. I have known myfelf fome cafes of this latter kind, which eftablifh the fact. The defire, indeed, I was given to underftand, was even ftronger than in thofe more perfect fyftems that have the neceffary means of procreating, and conftant opportunities of procreation *.

That œftrum would be fuppreffed in the female by the total extirpation of the ovaria, is proved by the apathy fhe feels, even in thofe cafes where fhe cannot receive the excitement through the medium of the fexual organs alone.

Exper. 5. Dr. Haighton being furnifhed with

* Les eunuques auxquels on n'a laiffé que les tefticules, ne laiffent pas de fentir de l'irritation dans ce qui leur refte, et d'en avoir le figne extérieur, même plus fréquemment que les autres hommes: cette partie qui leur a été laiffée, n'a cependant pris qu'un petit accroiffement, fi la caftration leur a été faite dès l'enfance; car elle demeure à peu près dans le même état où elle était avant l'opération. Un eunuque fait à l'age de fept ans eft, à cet égard, à vingt ans comme un enfant de fept ans: ceux, au contraire, qui n'ont fubi l'opération que dans le tems de la puberté, ou un peu plus tard, font à peu près comme les autres hommes.

Dictionnaire Raifonnée, tome vi. p. 147.

a rabbit in high breeding, feparated the connexion which the fallopian tubes poffefs with the ovaria, by cutting out about $\frac{1}{8}$th of an inch of each: the parts healed prefently: the venereal appetite was not only deftroyed for the time, but it could never be made to return: he kept her a month longer in a ftate of high feeding, and admitted her to the male a fecond time, but the fame reluctance continued. In another cafe he merely divided the tubes, without cutting out a porion of them; and although the rabbit was in a high breeding condition, fhe never could be excited for the fpace of three months, notwithftanding the frequent folicitations of a very animated buck. On examination after death, it was found that the divided extremities of the tubes adhered firmly to the loins, and that the canal of thofe parts was fo perfectly obliterated, as neither to admit air or quickfilver to pafs through: and the ovaria themfelves were much fmaller, and had degenerated from their natural ftate.

If the feparation between the generating and fexual organs, inftead of being complete, is partial only, there is a diminution only, but not a total obliteration of œftrum.

Exper.

Exper. 7. Two other rabbits, full grown, and perfectly healthy, had *one* of the tubes divided: the male was offered to them ſeveral times during the ſpace of three months: although they generally refuſed, they received him twice or three times each during this interval, but neither was impregnated.

In three other caſes the œſtrum was, notwithſtanding, found ſo ſtrong, that there were corpora lutea in both ovaria, but fœtuſes of courſe on the perfect ſide alone.

It would therefore appear, that whilſt a connexion between the ſexual and generating organs, through the medium of the uterus and fallopian tubes, is neceſſary to excite the evolution, and preſerve the whole, in a proper ſtate, after they are evolved; that the act of ſexual intercourſe is the neceſſary means by which their ſpecific power is excited, and the ova made to burſt from their incloſure in the veſicles with which the ovaria are filled.

CHAP.

CHAP. VII.

OF PROPAGATION IN THE HUMAN SPECIES.

The motives totally different from those of brutes—in them it is instinct without choice: in the human species it is an act of choice, from an exertion of reason—the evolution of reason frequently anticipates the perfection of the organs—the evolution of the organs of generation suspended until the middle period of life—the nymphæ and hymen, barriers to the sexual act when premature.

FROM what I have proved, it evidently appears, that the means by which the propagation of the species is effected, is far more simple in vegetables than in brutes, and especially than in those of a higher class: in the former, it is far more simple, and consequently more effectual, because each system possesses the totality of the means within itself: on the contrary, in the higher order of animals, the power does not reside in one system or in one sex, but in two different systems of different sexes. Where the means are so compli-

cated,

cated, the end muſt conſequently be more uncertain; before theſe different ſyſtems can unite, the ſexes muſt firſt be diſtinguiſhed and aſcertained, and attachments firſt formed between both. It is the conſequence of theſe motives, that animals of the ſame ſpecies propagate with each other in preference to thoſe of a different claſs. The inſtinctive knowledge of the lower order is of the moſt perfect kind; becauſe, as I ſaid before, the relation which the organs of ſenſe, or of inſtinct, bear to the brain, or organs of conſciouſneſs, is the relation of *power*; the weakneſs of reaſon therefore yields to the impulſe which it receives from the organs of ſenſe, becauſe this impulſe cannot be counteracted or controuled. As we proceed from the lower to the higher order of animals, the relation that ſubſiſts between the organs of ſenſe and the brain proportionably diminiſhes: where the power of volition is more ſtrong, the inſtinctive impulſe is proportionably weak; the power of both becomes as it were balanced. But when we aſcend to the human ſpecies, the proportion is totally reverſed: inſtead of having large organs of ſenſe, and a ſmall brain, there is a large brain, and organs of ſenſe comparatively

paratively ſmall: the organs of ſenſe therefore do not, becauſe they cannot, convey to the mind impreſſions equally ſtrong as thoſe which the brute, and eſpecially the lower ſpecies, are wont to convey: the pre-eminent power of mind, either ſuppreſſes or ſubdues the impreſſion it receives from the organ of ſenſe, and acts from rational motives alone. In the human ſpecies therefore—(I ſpeak of it in its improved and cultivated ſtate)—it is the MIND; which having acquired a paramount and preſiding power over the organs of ſenſe, renders them wholly ſubſervient to its controul. The act of propagation is then an act of choice, not of neceſſity; it is then that MIND ſeeks for objects congenial to its own nature; and where more attention is paid to mental perfection than corporeal beauty, love and attachment enſue, and conſtancy between the ſexes is ever the diſtinguiſhing characteriſtic of a chaſte and cultivated mind: this is the true ſource of moral affection, and the only bond of conjugal fidelity *.

"Oh!

* With a view of ſhewing how many motives are neceſſary for men who lead an intellectual life, to indulge

in

"Oh! happy ſtate, where ſouls each other draw;
"Where love is liberty, and nature law!"

If the act of propagation in the human ſpecies were merely an animal act, it would begin as in vegetables, and in the lower order of brutes: it would only begin when the evolution of the organs was complete: it would be confined to particular ſeaſons, and it would ceaſe altogether when the power in the female to conceive was at an end. On the contrary, if it were totally a rational act, the diſpoſition in many individuals would begin before the

in ſexual intercourſe, and how readily the appetite may be nauſeated, I ſhall ſtate what a literary character declared of himſelf: he declared, that he never had been tempted to indulge this kind of appetite but once, with a very pretty girl which he ſaw: after all the preliminary matters had been arranged between them, it unluckily happened, that he diſcovered ſhe had on black ſtockings; all hunger went off from that moment, and he could not attempt the action he had intended to fulfil!!!

*** It may perhaps be departing, in ſome degree, from the gravity of the ſubject, by relating the above caſe. I conceive, however, that authors have a right to illuſtrate the ſubject on which they treat, in their notes, although not exactly conformable to the text: in this I am ſanctioned by Gibbon himſelf.

ſyſtem

fyftem at large had attained a fufficiency of power and perfection *.

The evolution of reafon in the human frame, although it is very different in different individuals, often anticipates the evolution of the fyftem in general, and of the organs of generation in particular. Attachments are formed between children of different fexes, long before the final caufe of their attachment can poffibly be attained: it would therefore feem to have been with a view of encouraging the moral good that arifes from thefe attachments, that the Deity, in the fabrication of the human fpecies, has fufpended the evolution of the organs of generation, until the rational power is fufficiently matured to direct the organs of voluntary motion to their proper end. The evolution of thefe generating organs is progreffive: their power of action either does not begin, or at leaft is not perfected, until the organs of confcioufnefs and of voluntary motion are fufficiently matured to

* With fo much abhorrence have the legiflators of moft countries viewed the premature connection of men with young women, that the moft fevere laws have been enacted, and death itfelf is the common punifhment to which the violators are doomed.

direct the fexual organs to their proper ends: this power gradually decreafes at the latter period of life, and entirely ceafes at the dotage of old age.

If the female of the human fpecies, were led by the force of inclination to fexual intercourfe, before her conftitution had acquired a fufficiency of ftrength to fupport herfelf, and the offspring fhe had in confequence conceived, the end would be deftructive of the means; her imperfection and weaknefs would prove inefficient; and the death of herfelf and of her offspring would be the inevitable confequence.

To avert thefe evils from taking place, the female conftitution is guarded by various reftraints: the nymphæ are too fmall; the hymen is too large; refiftance is confequently increafed, and cannot be overcome without inflicting confiderable violence and pain.—Thefe peculiarities in the humanframe point out an unfitnefs in thofe parts to be employed at too early a period of life; they conftitute the external barriers as it were in the female fyftem, by which fhe is prevented from yielding to the influence of inclination when the gratification of it is premature.

Left

Left however these restraints should be surmounted, and sexual intercourse take place, it is impossible for conception in consequence to ensue; unless a certain aptitude in the uterus exists, and its evolution be sufficiently attained. This aptitude is manifested by the process of MENSTRUATION.

Of Menstruation.

It appears to me to be the distinguishing characteristic of the rational from the irrational animal. In vegetables, or in the lower order of brutes, it is totally unnecessary, because the propagation of the species is in them an act of necessity, not of choice; and when it is over, the attachment between the sexes immediately terminates. It is partly necessary in the higher order of brutes, whose actions are guided by choice as well as necessity, but it is totally necessary in the human species.

The existence of menstruation is a test of corporeal aptitude to fulfil mental inclination; its cessation is a test that the aptitude is gone, although the inclination remains: it suspends the disposition to sexual union, without preventing mental attachment. If the inclination

tion were gratified as ſoon as it aroſe, and conception enſued; or, if the power of conceiving laſted as long as the inclination, it is very probable that it would begin long before, and that it would continue long after the perfection of the maternal ſyſtem. It is probable that it would be the very reverſe of what it is: inſtead of the power of conception being limited to the middle period of life, it is very likely that it would be in the extremes—in youth and in old age. If in youth, before the perfection in the organs is attained, it is impoſſible that the means could be efficient of the end: the maternal ſyſtem ought to be perfect herſelf, before ſhe can be the cauſe of perfecting: ſhe muſt herſelf be properly evolved, before ſhe can be a fit inſtrument of evolving another: this aptitude is therefore known by the proceſs of menſtruation.

In warm climates, menſtruation begins and ends ſooner than in the temperate or cold: in cold climates, it begins and ends later than in the temperate or warm: in warm climates, as the Eaſt Indies, it frequently begins at the early period of nine years; the aptitude to conceive immediately follows, and inſtances

ſtances are frequent of women being mothers at eleven or twelve years of age.

The aptitude to conceive ceaſes at twenty-five or thirty, and a woman may be ſaid to be borne down with age, when ſhe has attained her fortieth year; ſo that human life ſeems in this reſpect to reſemble vegetable exiſtence, the rapidity of whoſe evolution tends to ſhorten and limit the period of its duration.

That the *uterus* is the organ from whence the menſtrual diſcharge is produced, is proved by facts too deciſive to be rejected. In the caſe of inverſio et prolapſus uteri, the capillary veſſels that terminate on the ſurface have been ſeen to produce it; and in caſes of the imperforated hymen, where the menſtrual diſcharge could not be expelled, the uterus has been found diſtended with an accumulated quantity.

The particular periods of evolution which the organs of generation in different animals ſuſtain, extend to the human ſpecies alſo: during the period of infancy, ſuch a quantity of blood is determined to the uterine ſyſtem, as is ſufficient for its preſervation and evolution alone: on the contrary, when it is arrived at a certain age, there is not only a large quan-

tity of blood determined to the uterine ſyſtem for the purpoſe of its evolution, but of ſecretion alſo.

It is with a view of preſerving this aptitude in the human ſpecies at all ſeaſons, not like that of brutes at particular ſeaſons, that this increaſed determination of blood is found ſo frequently to return. That the moral motive may find no impediment in attaining its final cauſe, by any imperfection or inaptitude in the organs through which it is to be obtained, this increaſed determination of blood on the uterus generally takes place every month, and has from thence received the appellation of *Menſtruation*: the regularity with which it returns, has been generally ſuppoſed to proceed from habit or cuſtom.

That it is not from habit is proved from this, that it begins before any ſuch habit has exiſted; and that it does not continue from habit or cuſtom is proved by the very ceſſation of it, after the conſtant and regular repetition of it ought to have eſtabliſhed the habit in a moſt perfect degree. But it is at this very period, when not only the habit of its repetition, but a total ceſſation alſo is found to

take

take place. Habit therefore can never replace that which no habit did produce, and which ceaſes when the habit ought to have been moſt regularly eſtabliſhed, and made to continue.

Increaſing the quantity of blood in particular parts, is the means which the principle of life employs to impart an increaſed degree of power to them.

The increaſed quantity of blood which is determined at the period of puberty, to the ſexual as well as to the generating organs, extends to the uterus alſo: to the ſexual, it is evident by the ſudden development they undergo: to the ovaria, it is proved by the proportional increaſe they likewiſe ſuſtain: to the uterus, it is proved by the effuſion that takes place. Although inſtances are occaſionally found in this country when menſtruation has begun at ten, and been retarded to twenty years or later, we may ſtate the natural period of its commencement to be fifteen; and that it terminates at forty-five; ſo that, if we ſuppoſe the natural life of a woman to be ſixty years, it may be ſtated that ſhe poſſeſſes the aptitude to generate exactly half the period of her exiſtence. Before the age of fifteen, ſhe has not attained a

 ſufficiency

ſufficiency of power to nouriſh her offspring and herſelf; and after the age of forty-five, ſhe retains a ſufficiency of power for the ſupport of herſelf, but not enough for herſelf and her offspring. Since then menſtruation points out the aptitude in the female ſyſtem to conceive, it is very evident that the ceſſation of it is a teſt of the inaptitude of the uterus to nouriſh and retain. If the power of conceiving laſted longer than the power of the uterus to nouriſh and retain, the power would be illuſory and void: if the power of conception, I ſay, laſted during the period of old age, when the maternal ſyſtem was on the decline, it is impoſſible that ſhe ſhould be capable of ſupporting her offspring and herſelf. After this ſyſtem has gone through the full period of its evolution, and when its powers are beginning to decay, the generating ſyſtem in general, and uterus in particular, firſt feels the change; becauſe, if the aptitude to conceive laſted whilſt the ſyſtem at large was unequal to the taſk of nouriſhing the maternal and fœtal conſtitutions, the deſtruction of one or both would be the inevitable conſequence. Such therefore are the laws by which the different parts of

of the animated ſyſtem are governed, that the *ſpecific* powers with which they are endowed, ceaſe by the abſtraction of the means alone by which they were produced; the quantity of blood determined to the uterus gradually diminiſhes; inſtead of a plenitude, not only for ſecretion but for nouriſhment, there is a bare ſufficiency for nouriſhment, but none for nouriſhment and ſecretion together.

N. B. The limits which I have preſcribed to myſelf, prevent me from enlarging upon this ſubject, and from inveſtigating the different opinions which have been entertained upon it. From what I have ſaid it will appear, that I conceive it to ariſe from a local plethora, and not from a general one *.

* Sir Clifton Wintringham, in his Experimental Enquiry, inſiſts very ſtrongly on the difference of evolution that takes place in particular parts at different periods of life: it is upon this doctrine alſo, that Dr. Cullen founded his doctrine of hæmorrhagy; it is the part of his work that ſeems founded on true phyſiological knowledge; and which, by the bye, he principally borrowed from Hoffman.

CHAP.

CHAP. VIII.

OF THE TESTES, OR GENERATING ORGANS OF THE MALE.

Of the defcent of the teftes into the fcrotum—affected by the diminution of the ligament to which they are attached—its fpecific power retarded till the middle period of life—the anatomical ftructure of the generating and fexual organs defcribed—of the fpecific action of the penis—by what means produced—the means by which it returns to its collapfed ftate, &c.

THE progreffive evolution which the generating organs of the male undergo, is not lefs obvious than thofe of the female; not only with refpect to action and fize, but to fituation alfo. The teftes are two in number: in point of fituation they are totally different in the fœtal, from what they are in the adult ftate. In the fœtal ftate, they are placed immediately below the kidneys; the pofterior part refting on the anterior furface of the pfoæ mufcles, covered over by the peritonæum, with which the whole abdominal cavity is lined. The teftes afford attachment

ment to a ligament of a pyramidal ſhape ; the baſe or broad part of which adheres to the inferior portion of the teſtes : the body of this ligament paſſes through the rings, formed by a ſeparation of the ligamentous fibres of the external oblique muſcles, to which it is attached ; and its apex finally terminates in the cellular ſubſtance with which the ſcrotum is lined *.

This ligament, which I have juſt deſcribed, ſeems to have uſually attained the full perfection of its evolution, in length, breadth and thickneſs, when the early period of ſeven or eight months of geſtation is expired. So conſiderable indeed is the magnitude which it has then attained, that the annular opening of the external oblique muſcle is conſiderably enlarged, in conſequence of the diſtenſion which the ligament affords : the peritonæum which lines the abdominal cavity in general in an even and regular manner, is particularly looſe at this point, and dips as it were a little way through the opening itſelf.

* The whole of the baſe, and as much of the body of this ligament as reaches the annular opening, is lined by the peritonæum alſo.

After the perfect evolution of this ligament is attained, and which generally happens at the period I have deſcribed, it gradually diminiſhes and contracts in ſuch a manner, that the extremities, which were at a conſiderable diſtance (the baſe which was attached to the teſtes ſituated in the loins, and the apex to the cellular ſubſtance in the ſcrotum), approximate each other; but the baſe and apex of this ligament cannot approximate each other without the teſtes ſuffering alſo an alteration in their ſituation. It therefore happens, that whilſt the ligament diminiſhes in length by the contraction * it undergoes, the teſtes covered by the peritonæum are drawn down from their original reſidence upon the pſoæ muſcles towards the annular opening: in their paſſage through this opening, they not only carry the covering which they had received in the loins from the peritonæum, but the fold alſo of the

* We have exactly a parallel inſtance of this kind of contraction, in the tranſition of the tadpole to the condition of a frog: in the firſt ſtate it feeds upon vegetable food, and the inteſtines are remarkably long; as it evolves, it lives upon animal food and inſects, and the inteſtines then contract and become remarkably ſhort.

peritonæum

peritonæum that dipped into the abdominal ring; the firft of thefe coats may be called tunica vaginalis reflexa; the fecond, tunica vaginalis. After the teftes have paffed through thefe openings, a complete union takes place at the upper extremity, fo that the teftes are involved and protected as it were, like a head in a double night-cap; the diftenfion which the ligament gave to the fibres of the external oblique mufcle is then removed; thefe fibres progreffively evolve, and fo completely clofe the aperture that fubfifted before, that, when the fœtal ftate ends, and the adult begins, the paffage is in general completely obliterated, and the abdomen and fcrotum form two feparate and diftinct cavities*.

Although

* Before the obliteration between thefe two cavities has taken place, it is very clear, that if there fhould happen to be any part of the abdominal contents pafs through the annular opening, fuch fubftance would be in direct contact with the tunica albuginea: it is this difeafe which Haller has called hernia congenita. On the contrary, in the adult ftate, after the annular opening has been clofed; if, through violence, any portion of the abdominal contents fhould pafs through the opening, it carries before it the peritonæum with which the abdominal cavity is lined; and this portion of the peritonæum it is which forms what

Although the teſtes have reached their ultimate deſtination in the ſcrotum, when the adult ſtate begins, it appears that in point of magnitude and action, their evolution is evidently more retarded than the evolution of many other parts of the ſyſtem ; they however become progreſſively unfolded, more eſpecially as the period of infancy terminates, and that of puberty begins: at that period they are ſo far perfected, that they poſſeſs the capacity of having the ſpecific power with which they are endowed, of being diſplayed into energy by the operation of thoſe cauſes

what is called the *hernial ſac:* in both caſes, therefore, the *proximate cauſe* of hernia is a dilatation of the ligamentous fibres of the external oblique muſcles, ariſing either from an original mal-conformation without any external violence, or from external violence producing a mal-conformation of the parts. I cannot detail here the exciting cauſes which produce this proximate cauſe, or the ſymptoms or effects which are in conſequence produced. The paſſage of the omentum or inteſtine through the opening, and its exiſtence in the inguen or ſcrotum, is an effect only, and not the proximate cauſe, as is generally ſuppoſed.

N. B. It is a little ſurpriſing, that Dr. Cullen, in his Noſology, inſtead of making hernia the firſt in point of claſſification, ſhould make it the very laſt.

neceſſary

neceſſary for that purpoſe; and when this is the caſe, a fluid is formed which has received the appellation of SEMEN *.

The teſtes are plentifully ſupplied with nerves. The blood with which the teſtes are ſupplied, comes from two trunks: they ariſe from the aorta; in both it is called ſpermatic: the trunks of the ſpermatic arteries progreſſively evolve with the teſtes, and become elongated as they proceed from the loins to the ſcrotum. After the ſpermatic arteries have paſſed through the abdominal ring, they divide into two branches; each branch appears deſtined to perform a diſtinct and ſeparate office; the one ſupplies with blood the tunica vaginalis and ſurrounding parts, the other en-

* It appears, therefore, that the generating organs of the male, like thoſe of the female, are ſuſpended until the mind is ſufficiently matured: if they were evolved and perfected before the power by which they were deſigned to be excited, and to which it is intended they ſhould be ſubſervient, they might be excited to action by improper cauſes; by a deſire of union perhaps with the brute, rather than with the human ſpecies; with the male, perhaps, rather than with the female; in ſhort, it is ſcarcely to be conceived what inverſion and perverſion of action might enſue.

ters

ters the body of the teſtis itſelf: after this branch has entered the ſubſtance of the teſtis, it ſuſtains conſiderable alteration in its ſtructure, by the repeated convolution it undergoes, it is increaſed in length in the proportion of three to one, it loſes its ligamentous coat, and conſequently collapſes like a vein.

As its length is increaſed by the effect of theſe convolutions, its capacity proportionably decreaſes, until its final termination into tubes which are called *tubuli ſeminiferi:* the term of tubes, which has been given to this part, would ſeem to be with a view of diſtinguiſhing the ſituation of one part from another: and not from any idea that it performed any different office; becauſe the ſpermatic artery continues by direct continuity, without any intermediate follicular ſtructure, from the one into the other. Such is the infinite minuteneſs with which the ſpermatic artery divides and ſubdivides in theſe parts, that Dr. Monro is of opinion that theſe tubes amount to 3,000 in number, and that the length of each is ten feet; ſo that, if the whole of them were extended in one line, the aggregate length would meaſure 30,000, whilſt the internal

ternal capacity would not exceed the 100th of an inch.

After theſe tubes are ſegregated into this multitude of parts, it is ſuppoſed that they gradually congregate together, forming a fine vaſcular net-work, and which is therefore called rete teſtis: theſe veſſels progreſſively increaſe in ſize and decreaſe in number, until we find them limited in general to ten or twelve; and they are then called *vaſa efferentia.*

The *vaſa efferentia* proceed upward, and form the epididymis: the tubes of which the epididymis is formed are greatly convoluted alſo; for if the whole be unravelled, it may be extended to thirty feet in length: the vaſa efferentia do exactly the oppoſite to what we have deſcribed the tubuli ſeminiferi: the tubuli ſeminiferi increaſe in number and decreaſe in magnitude; on the contrary, the vaſa efferentia increaſe in magnitude and decreaſe in number, until they finally terminate in one veſſel called *vas deferens.*

The *vas deferens* in ſtructure is turgid and ſtrong; and although this one veſſel is deſtined to receive the whole contents which the mul-

titude of veſſels convey which I have deſcribed, the internal diameter of it is very ſmall *.

It gradually enlarges in its progreſs; and after paſſing through the abdominal ring, proceeds towards the poſterior and inferior part of the bladder of urine; the internal ſurface becoming extremely cellular, ſomewhat like a honeycomb, before its final termination at the verumontanum.

The *verumontanum* is a little eminence placed upon the internal ſurface of the proſtate gland.

The proſtate gland is ſituated under the oſſa pubis, and conſtitutes the beginning of the urethra: in figure it is like a cheſnut; in ſtructure very vaſcular, and containing different follicles, from whence a thick cream-like fluid is ſecreted: this fluid is conveyed from theſe follicles by ten or twelve excretory ducts into the urethra.

The urethra is a canal of a membranous ſtructure, and plentifully ſupplied with glands:

* We may therefore be led from thence, in ſome degree, to conceive the infinite minuteneſs of thoſe veſſels, and the wonderful exility of the fluid they contain and convey.

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it arifes from the neck of the bladder, and terminates at the extremity of the penis, which is called glans, and from its expanded form has received the additional appellation of corona glandis: from the whole furface of the corona glandis a great number of nerves have their origin, and which render this part exceffively fenfible. Connected with this high degree of fenfibility which the glans poffeffes, in confequence of the quantity of nerve it contains, it is endued with the capacity of very great diftenfion alfo.

In its collapfed ftate it is covered over by a duplicature of the fkin, called preputium; there is connected not only with the glans, but with the urethra alfo, a body of a cellular ftructure, that has received the additional appellation of corpus fpongiofum: this cellular appearance feems to arife from the convoluted ftate of the veffels it contains when the penis is in a flaccid ftate.

From the under furface of the corpus fpongiofum, on each fide of the urethra, there are two bodies which are diftinguifhed for the fponginefs of their texture, and are therefore called *corpora cavernofa*.

 They

They are compofed of an affemblage of fmall cells, placed in the collapfed ftate of the parts contiguous to each other, but which poffefs the capacity of confiderable diftenfion. When they are excited to action there is a free communication between the corpus cavernofum of one fide, and the corpus cavernofum of the other, by frequent interfections fimilar to the teeth of a comb, and which is therefore called *pecten:* thefe bodies are attached to the offa pubis by a ligamentous union: the whole of thefe parts are fupplied with blood from four arteries which arife from the iliacs, and are called pudendal: each pudendal trunk divides into two branches: one branch on each fide ramifies upon the dorfum penis, and upon the fuperficial parts of the corpora cavernofa in general as far as the glans itfelf: the other trunk fupplies the corpus fpongiofum in particular with a more abundant quantity of blood for its nourifhment and fupport: the other two pudendal trunks dip into the cells of the corpora cavernofa: inftead of being fubfervient to the nourifhment and fupport of the penis, they are the neceffary means by which its fpecific action is produced.

Of

Of the ſpecific Action of the Penis.

No doubt can ſubſiſt, but that there are various means by which the ſpecific action of the penis may be excited: the natural one proceeds from the influence which the mind has upon theſe parts, by which an increaſed quantity of blood is determined into them: we know this to be the fact, but the cauſe why it takes place ſeems involved in conſiderable obſcurity. It can, I conceive, be only explained by the relation that ſubſiſts between the nervous and the vaſcular ſyſtem, and the degree of power which the one ſeems to poſſeſs over the other. This relation of power which the nerves poſſeſs over the vaſcular ſyſtem, is proved by various inſtances; it is proved by a bluſh in the cheek, from a conſciouſneſs of ſhame; by an increaſed ſecretion of ſaliva; from the greedineſs of the appetite, eſpecially if it be further excited by the impreſſion of flavour, which the mind may receive through the olfactory ſenſe. And finally it is proved by the changes which the penis itſelf ſuſtains, either from the ſenſuality of the imagination alone, or more eſpecially from

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the intercourſe and converſation of an agreeable woman, when a vehement deſire for ſexual union exiſts: it is thus that the ſenſibility of the nerves with which the corona glandis is ſupplied is greatly increaſed.

The trunks of the pudendal artery which I have deſcribed, as being more eſpecially ſubſervient to the ſpecific action of the penis, have an increaſed quantity of blood determined into them, the various ramifications which proceed from thoſe trunks become diſtended, and the cells of the corpora cavernoſa filled with blood: the veſſels with which the corpus ſpongioſum is ſupplied, undergo the ſame addition alſo: it is by the increaſed quantity of blood which is effuſed into the parts I have mentioned, that the penis becomes changed from its flaccid and paſſive ſtate, its capacity enlarged, and erection the effect ultimately produced *.

This condition of the penis conſtitutes the neceſſary means, by which the ſpecific action

* The different muſcles with which the penis is ſupplied, all co-operate in propelling the blood forward and perfecting this ſtate: viz. the two erectores penis, acceleratores urinæ, and tranſverſus perinæi.

of

of the fœcundating organs of both ſexes is excited to perform the actions which are eſpecially allotted to them: in the female, the evolution of the ova from the veſicles which the ovaria contain; in the male, the ſecretory power of the teſtes, and the production of *ſemen*. It is unneceſſary for me to detail the ſenſible properties of ſemen, as many have attempted to do: ſome have ſought to find out its virtues by the ſtink it is ſaid to impart; others by the flavour; ſome by its colour, and others again by its conſiſtence: it is however very evident to me, that its power does not reſide in any of the ſenſible properties it contains, and that, if it were analyſed, it would yield the ſame product as mucus or ſaliva; or perhaps like the interſtitial fluid itſelf. It is not therefore in the chemical qualities which theſe different ſubſtances poſſeſs in common with each other, that we are to ſeek for the ſpecific and particular power of each: the ſenſible qualities of each conſtitute the vehicles only through which the energy of the ſpecific power is imparted, and are the media only through which it is exerted. Semen is the recipient by which the paternal character is

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received, and the penis conſtitutes the medium by which it is conveyed to the ovum which the female evolves. It would ſeem a neceſſary conſequence, that this recipient ſhould be in its nature moſt ſubtle and refined; in order that the thing receiving (the ſemen) ſhould be accommodated to the principle received (Life). It is no doubt with a view to this principle ſo univerſally true, that it admits not of any one exception, that the fœcundating organs of the male are ſo particularly conſtructed; the tubuli ſeminiferi, ſo infinitely ſmall, that none but the moſt rare particles of blood can be permitted to flow through; and the whole excretory duct correſpondent in its fabric. When I reflect on the œconomy and uſe of theſe parts, I am led to doubt, whether ſemen be that thick opaque ſubſtance it is deſcribed to be: on the contrary, I ſuſpect, that it is as tenuous and ſubtle as the cavities by which it is contained, that it may correſpond to the immaterial nature of the living principle which it is deſtined to receive, and that the fluid which the veſiculæ ſeminales produce is the vehicle in which the ſemen is involved, which gives it conſiſtency and bulk, and through

which

which it is conveyed from one ſex into the other.

The *veſiculæ ſeminales* are two in number, ſituated on each ſide of the vaſa deferentia: the peritonæal covering they receive, imparts a ſmoothneſs to their external ſurface: on the contrary, the internal one is extremely cellular; the cellular proceſſes go off with conſiderable uniformity, in lateral directions; they bear a very ſtrong reſemblance, in point of ſhape, to the cells I have deſcribed, as exiſting at the termination of the vaſa deferentia; but they differ from them by the extent of their magnitude: the internal ſurface is lined by a membrane which is particularly vaſcular, as is manifeſted by the appearance it diſplays when properly injected by a coloured fluid. Not the analogy alone that ſubſiſts between the internal fabric of the vaſa deferentia, and of the veſicles, but the contiguity of their ſituation alſo, would ſeem to ſhew that they are deſtined to co-operate, and be ſubſervient to one and the ſame office. There are various claſſes of animals that are deſtitute of theſe veſicles, and where the vaſa deferentia anſwer the purpoſe altogether.

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In birds, the vas deferens terminates at once by an open orifice; and there are fome carnivorous quadrupeds, as lions, cats, bitches, and a variety of others, where the veficles are altogether wanting; and in thofe fyftems where they are found to exift, there is a confiderable difference in their internal ftructure, and in the extent of their furface; the figure varying from a fimple bag with one cell, to the complicated figure we behold it in the human fpecies. Not only the difference of its appearance, but the termination of the excretory duct varies alfo. In fome animals, as the bat, beaver, dormoufe, rabbit, guinea-pig, bull, horfe, monkey, &c. there fubfifts no communication between the vafa deferentia and the veficulæ feminales; the excretory duct of the former terminates, feparate and diftinct from the excretory duct of the latter; fo that if an injection be paffed into the one, it will not permeate and fill the other. On the contrary, in the human fpecies, although the communication is an indirect one, it does fubfift; the excretory ducts of both are fo united, that when an injection is thrown from the vas deferens, part of it will regurgitate and fill the

veficulæ

veficulæ feminales, and the remainder pafs into the urethra; the excretory duct diminifhes in capacity towards its termination at the verumontanum; fo that it is poffible that regurgitation may take place into the veficulæ feminales. The paffage, however, from the vas deferens to the urethra is direct; from the vafa deferentia to the veficulæ feminales, it is an indirect one: it is not therefore warrantable to fuppofe, that thefe bodies are deftined to be the immediate recipients of femen; but on the contrary, that they themfelves fecrete a fluid which unites at the termination of the vas deferens, during the fexual act, with the femen; by means of which the whole is perfected. It is probable that the verumontanum is furrounded by a fphincter mufcle, too fmall indeed to be detected, but fufficiently ftrong to retain (within certain limits) the fœcundating fluid; but when the accumulation of it is too abundant, the refifting power of the parts yields to the preffure they fuftain; relaxation enfues, and the whole of the fœcundating fluid paffes from the excretory duct of the teftes and vefícles (of which the urethra may be confidered as a part) into the fexual organs of

of the female frame; from whence we may prefume it is conveyed through the medium of the uterus into the fallopian tubes, that it may be ultimately applied to the furface of the ovaria; the final caufe of fexual intercourfe attained, and fœcundation produced.

There are various mufcles which are connected with the parts I have defcribed, that all confpire to produce this effect; the cremafter mufcle, which arifes from the inferior portion of the teftes, and terminates along the fpermatic chord, tends by its action to propel the femen upwards from the teftes to the vafa deferentia: the levatores ani, by preffing the veficulæ feminales, act to evacuate the fluid which the vefìcles contain: the ejectores feminis (i. e. the acceleratores urinæ) propel by the power of their contraction the whole of the fœcundating fluid into the urethra: and finally, the erectores penis, by preffing the crura and corpora cavernofa of both fides againft each other, diminifh the capacity of the urethra, to the total obliteration of this canal.

I am aware that great difficulty exifts to afcertain the fact, whether femen do or do not pafs

paſs into the uterus. I ſhall not avail myſelf of the neceſſity that would abſolutely ſubſiſt, if Leuwenhoek's obſervation were true, that animalcules exiſt in the ſemen, becauſe I am convinced that thoſe obſervations are falſe. I muſt however obſerve, that the immortal Haller ſaw ſemen once in the uterus of a ſheep, although he could not detect it in many other animals which he examined. Verheyneus ſaw it in a cow; but the facts which ſeem to bear more ſtrongly upon the caſe, were aſcertained by Ruyſch. He opened the bodies of two women, who died immediately after the ſexual act: one of them had been diſcovered in the act of fornication, and killed by her huſband: in the other, a common ſoldier had connection with a proſtitute, and after the connection was ended he was ſeized with a violent fury, and ſlew her. In both caſes he declared, that he not only found ſemen in the uterus but in the tubes alſo. And finally I have been informed that Mr. Hunter, having ſeen a bitch in a ſtate of union with a dog, killed her at once by cutting the ſpinal marrow aſunder: on examining the uterus, he found that it did contain ſemen.

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The clofe and endearing relation which the individuals of the human fpecies bear to each other in fociety, prevents the fame obfervations from being made upon them that we have detailed upon the brute creation: we may however prefume, fince the end is attained by the fame means, that the fame proceffes take place, and that the fame alterations are obfervable in the organs of both. If the conclufion be true, that in different animals corpora lutea are often formed without impregnation, it may become a queftion, whether a corpus luteum might not exift, in fome folitary cafes, in the female of the human fpecies without impregnation alfo; in confequence of the influence of œftrum, arifing from the vehement force of paffion, encouraged and induced by particular means. I ftate it as a matter of curious enquiry more than of real utility. "Nullum corpus luteum," fays Haller, "in virgine, nullum in virgineis animantibus unquam obfervavi." It muft however be obferved, that Dr. Haighton, whofe accuracy of obfervation and extent of anatomical knowledge are well known to me, and who fides in opinion with Baron Haller, fays, "that he has feen more

than once a recently formed corpus luteum in the human ſubject *without* a fœtus; nay, even in a ſubject where there has been a kind of *hymen*: but he adds, that the uterus in theſe caſes has borne the marks of an early and recent abortion *."

When the criſis is accompliſhed, the ſpecific action of the different parts terminates, and a general languor of the ſyſtem enſues. The pudendal arteries, which conveyed an increaſed quantity of blood to the corpora cavernoſa and corpus ſpongioſum, and through which they were filled and diſtended, from over diſtenſion become weakened and exhauſt-

* I by no means deny the poſſibility of impregnation taking place whilſt the hymen continues perfect. I know it has happened, and was witneſſed by a medical gentleman with whom I am acquainted. When, however, we connect the exiſtence of an hymen, and of a corpus luteum, *without* a fœtus, I think it reaſonable to conclude, that no fœcundation had taken place, but that an evolution of the veſicle was the effect of œſtrum; encouraged by means to which ſome women indulge, whoſe imagination is debaſed, degraded, and debauched; and that the appearances of a recent abortion were none other than what aroſe from the increaſed determination and accumulation of blood that takes place, at thoſe times, upon thoſe parts.

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ed, and ſcarcely convey as much as they were uſed to do in the collapſed condition of the parts. It was owing to this increaſed and accumulated quantity of blood that was determined into theſe parts, when the ſpecific action was diſplayed, that diſtenſion took place, and erection was the ultimate effect: it took place becauſe the veins, although able to carry away the uſual and ordinary ſupply, are unequal to the taſk of removing the quantity when it is exceſſive: it is by the increaſe of power the arteries have over the veins, therefore, that erection is produced: on the contrary, it is owing to the relative power of the veins over the arteries that erection ceaſes, and the ſexual organs are reduced from their active to their paſſive ſtate. It is probable, that the returning veins not only carry away an increaſed quantity, but that abſorption by veins alſo takes place from the cells of the corpora cavernoſa. We may in ſome degree be led to eſtimate the quantity of blood which is determined into theſe parts, by comparing the relation which the arteries bear to the veins: the arteries we have ſtated to be four; on the contrary, the returning vein is limited to one (the vena magna ipſius penis):

weakened

weakened and exhauſted, therefore, muſt be the effect produced upon the arteries; the accumulation of blood, inſtead of increaſing as before, cannot even be continued: ſo that, after the ſexual act is accompliſhed, the different parts return to the paſſive and collapſed ſtate which they were in before. Nothing but the neceſſity of preſerving ſome degree of regularity in inveſtigating the different inſtruments by means of which the various actions of the ſyſtem are carried on, could have led me to dwell ſo long as I have been obliged to do upon the preſent ſubject. I have now the more pleaſing taſk of tracing the evolution which the embryo ſuſtains, until its ſeveral parts are perfectly developed, and the adult ſtate begins; and finally, of explaining the various actions incident to the animated frame, until its ultimate diſſolution.

END OF THE FIRST VOLUME.